Downhill Ski Area

Alberta

RECREATION AND PARKS

Recreation Development Division

Downhill Ski Area

Planning and Operation

Alberta
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Community
Recreation Branch

Outdoor Recreation Facilities
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ABSTRACT

DOWNHILL SKI AREA

PLANNING AND OPERATION

Revised Edition 1986

Alberta Recreation and Parks

Community Recreation Branch

Outdoor Recreation Facilities Section

Editor, Clive Callaway

Cal-Eco Community and Recreation Planners Ltd.

Updated, partially rewritten and re-organized, this revised edition provides proponents of new or expanded, community and regional downhill ski areas with an outline to plan, design, construct, operate and maintain their facility.

A list of government agencies, commissions and boards having regulatory control over development and operation is included.

KEY WORDS

Ski area planning, concept and master planning. Ski area management.

Ski Areas

Westcastle Park
A REGIONAL SKI AREA

Edmonton Ski Club
A COMMUNITY SKI AREA

Canyon Ski Area
A REGIONAL SKI AREA ALSO
SERVING THE RED DEER COMMUNITY

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Co-operation and input provided by the Canada West Ski Areas Association, various ski area operators and/or their managers, private consultants, industry, education and government representatives is greatly appreciated.

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Clive Callaway

Editor

Calgary, Alberta

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PREFACE

Much has been written on the subject of ski area planning since the first edition of this manual was published in September 1976. The Editor in conjunction with Alberta Recreation and Parks, felt that this current edition should change in format to reflect the extent of this knowledge. It was decided that, rather than provide a comprehensive technical manual, a more general overview would be provided in conjunction with some detailed sections. In addition, planning guidelines and checklists would be presented and wherever possible references to sources of more detailed information would be included.

All chapters have been renumbered and retitled, new sections have been added and the original Chapter 6, entitled "Ski Area Case Studies", has been eliminated since the "Canada Ski Directory" and the "White Book of Ski Areas" provide adequate descriptions of many Alberta ski areas.

The bibliography has been expanded and covers the past fifteen years.

The manual is a step by step guide through the preliminary planning, concept and master planning process for a ski area. Checklists, guidelines and references to more detailed design and technical information are incorporated throughout. General comments on the operation and maintenance of ski areas with relevant checklists are also included as part of the ski area management process.

The entire work is essentially an information manual and contains numerous references to recent publications, associations and recognized educational and job training programs that have been developed over the past decade.

Some information was gathered directly by the Editor as part of a consulting role for this edition and partly as a result of a Masters Degree research and case study project at the University of Calgary, Alberta. Some results of this work have been absorbed into the reorganized and rewritten text and, it is hoped, have filled in some of the missing links of information on ski area planning.

INTRODUCTION

If you are considering a new or expanded downhill ski development, or have an interest in ski area planning and operation, this manual should be of assistance to you, your staff, volunteers and consultants.

Whether you are a private developer, a public body, a non-profit organization, or an interested individual, this manual will take you step by step through the process of developing an idea to operating and maintaining the finished product.

This revised edition has been updated, partially re-written and re-organized primarily to provide developers of new or expanded community and regional ski areas with an outline to plan, design, construct, operate and maintain their facility. It also provides a complete list of government agencies, commissions and boards that have regulatory control over development and/or operation (see Appendix B).

The "Mt. Allan Master Plan - Summary" document offers the following generalized description of a ski area:

> " .... Ski area development is generally considered to be a non-consumptive use of the land as skiers basically only take pictures and leave tracks in the snow. The development of ski lifts and trails requires the removal of approximately 20% of the forest canopy. Ski lift rights-of-way are characteristically 12-15 metres (40-50 feet) in width, while ski trails vary between 30 and 60 metres (100 to 200 feet) wide. Subsequent to forest removal, the ski trails require the removal of all stumps and debris and fine grooming and seeding to establish a grass cover which prevents erosion and minimizes hazards and damage to the skiers and the snow grooming equipment. Ski lifts are aerial cable systems used to transport

skiers up the mountain with steel towers and concrete foundations every 50-80 metres. A standard forest access road is also required for lift and trail construction and the long term operation and maintenance of the mountain. Ski base area development generally includes a paved access road, gravel parking lots and buildings for a day lodge and maintenance centre. Additionally, appropriate power and water supply and sewage disposal facilities are required to support the base area improvements.

In addition to these basic ingredients of a ski area, it is fair to suggest that in recent years a new fundamental component has been added. Snow making capacity is presently being viewed as critical to the economic viability of a recreational ski area. It has been said that no new ski area in North America today would be developed without the capacity for snow making, and this trend has been evidenced through the tremendous increase in the number of existing ski resorts which are installing systems. Even in high snow fall areas, snow making is considered essential to ensure a full ski season and maximize revenues - especially during the critical Christmas/New Year period when ski facilities expect to generate up to 30% of seasonal revenue ...."

There are no firm definitions of ski areas in Alberta. However, the "Mount Allan Ski Area Master Plan" suggest the following classifications:

Community Facility - 150-meter or less vertical drop; ski trails predominantly beginner and low intermediate and less than 40 hectares; rope tow, handle lift or T-Bar; servicing primarily the local population and school groups.

Regional Facility - Approximately 450-meter vertical drop; ski trails predominantly beginner and intermediate with some advanced; rope tow, T-Bars, chairlift; located where community areas have less facilities, thereby making this facility attractive to communities within a two-hour drive.

Development of a ski area requires forethought. An organized planning process can eliminate costly errors and provide for a more efficient operation of your ski area. Although the nature of the planning process remains the same for any area, inputs vary according to:

- the scale or magnitude of the development
- the developing authority/owners
- the program of activities to be offered

Some phases of the planning process may require professional services and some may only require knowledgeable lay people.

A ski area is not just a downhill ski operation. In todays market and with the high costs of facilities many areas must broaden their scope of activities. Opportunities are discussed for multiple use of many areas together with extended winter operation through careful planning and grooming of slopes. This can be supplemented with snow moving and snow making equipment and night time activities.

Discussion on base area facilities has been limited to the needs of day users at the ski area. Accommodation planning is not included in this manual, for more information refer to "Planning Resort Community: Some Definitions, a Brief History and Bibliography with Selected Annotations". For this and other references check the bibliography section of this manual.

This revised edition has four key chapters:

I Preliminary Planning and The Concept Plan

II The Master Plan

III Design and Construction

IV Operation and Maintenance

These elements are not mutually exclusive, for example, the planning process requires design, construction and operational input in order to be effective.

The ski industry has matured over the last decade and as was mentioned in the preface to this revised edition much has been written on the subject. In addition to this manual the reader would do well to consult with the industry's association, the Canada West Ski Areas Association (CWSAA) and to review the periodical "Ski Area Management" to keep up to date with trends and technology.

Apart from drawing on the first edition of this manual, information has been quoted from the following key reports and manuals:

- "Mt. Allan Master Plan - Summary"
- "Ski Resort Planning and Development"
- "Commercial Alpine Skiing Policy, Section 3.4.0200" - (British Columbia)
- "National Forest Landscape Management Ski Areas Volume 2, Chapter 7" (United States Forest Service)
- "Ski Resort Manual" - (Ontario)

Other references are included throughout this work. The key references are worth reviewing if you wish to gain a better understanding of the subject.

There is no guaranteed right way of planning and designing your ski area although there are industry norms and emerging standards. Consultants, operators and the subject literature can vary substantially in opinions and design standards.

Design criteria are a function of many variables, and are discussed in Section 3.02. The key to the best solution lies with a good planning and design team and a review of the successes and failures of other projects. Time spent in analysing these is worth its weight in gold.

The planning process for a ski area is a complex task which involves the following basic activities:*

- The identification of all the factors which need to be addressed to design a ski area for recreation and sometimes competition use
- An inventory and/or analysis of each factor, including the identification of opportunities and constraints for development and operation
- Issues identification and resolution

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* Derived from "Mt. Allan Master Plan - Summary."

- Program definition leading to the preparation of conceptual building and site development options including design layout
- Detailed evaluation of program and design options
- Development of capital cost estimates
- Preparation of an operational and financial plan for the area
- Preparation of an environmental protection plan for construction and operations
- Development of an implementation strategy and schedule

The information contained in this manual alone is unlikely to qualify you to plan, design, construct, operate and maintain a ski area. It can, however, point you in the right direction and, hopefully, assist you in communicating and possibly directing others towards a successful project.

Preliminary planning and the concept plan are the first steps in the development of your ski area.

CHAPTER I

PRELIMINARY PLANNING AND THE CONCEPT PLAN

1.01 What is Preliminary and Concept Planning?

In the "Yes, You Can! Master Plan" series, Alberta Recreation and Parks suggest that planning is vital in separating facts from opinions about the need for recreation services. The preliminary planning process for a ski area looks closely at these needs and the available market, i.e., skiers, that might use the facilities if they were provided.

Preliminary planning involves the following activities:

- developing a planning team or organization for ideas and help
- setting goals and objectives
- analysing the market and assessing needs
- examining alternate sites
- studying just how feasible a ski area might be on one or more alternative sites

Once the preceding has been done it should be possible to develop the conceptual plans. Usually feasibility studies and other factors will have narrowed down the choice of sites, hopefully to one, in order to avoid additional expenditures. The concept plan is an idea for what might be developed on a given site having regard to the results of the preliminary research and planning.

This plan will include items such as the physical characteristics of the site and how they will effect your development. All such information will be evaluated and drawings made indicating a potential development picture with ski runs, lift or tow lines, base facilities, access roads, etc. Refer to Section 1.08. The information may be shown graphically and/or with sketch plans in conjunction with a written report.

In the experience of ski area operators, planning is vital in reducing costs, avoiding wasted effort and meeting deadlines.* It provides consideration of alternatives and if done well provides for change in the future. Planning helps to identify potential issues, concerns and opportunities and is invaluable in gaining support for your project, especially in obtaining financing and preliminary development approvals.

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* From "The Copper Mountain Story".

1.02 The Planning Team

Ski area planning, design, construction and operation draws on a multitude of skills.

The planning process can only proceed so far when done by an individual or even a dedicated group of volunteers. Professional input will usually be needed at some point.

Whether your project is started by a ski club, local entrepreneur, recreation board or recreation department staff member, you would be well advised to consult at least with Alberta Recreation and Parks, Community Recreation Branch, Outdoor Recreation and Sport Facilities Section and/or the CWSAA (see Appendix "C").

If you are a public body or non-profit organization you may choose to establish a planning committee which might consist of:

- a local community representative
- a consultant from Travel Alberta
- a consultant from Alberta Recreation and Parks
- a representative skier
- an individual with considerable experience in the ski industry
- the local municipal recreation director

The purpose of this committee would be to organize and review all information and recommendations arising from the preliminary planning process. The committee may continue to oversee the actual development of the area. The planning process should continue to ensure the plan is carried out as planned and updated as needed. If the planning committee takes on the responsibilities for overseeing the total project, it might hire specialized professionals for short term tasks as required.

A hired planning team of professionals might include any one or more of the following:

- an economist/market analyst
- a recreation planner
- a landscape architect
- an architect
- an engineer
- an experienced skier/instructor

Alternatively you may choose to go to one of the ski area professional planning consultants, a selection of whom can be found in appendix "D".

1.03 Setting Your Goals and Objectives

Whether you are an individual, group or planning commitee it is important that you establish your goals and objectives very early in the planning process. Unclear or unstated goals and objectives can result in confusion and/or result in delays and excess or unnecessary expenditures.

Goals should be established for the ski area which take account of, among other things:

- the needs of the community
- the market in general
- extent of services to be offered
- concerns and issues

Priorities can then be established which can serve as some of the objectives for long range development plans. Objectives themselves may change during the course of the planning and development process. It is very important that the objectives be established and monitored in order to avoid cost overruns and time delays as previously mentioned.

Goals and objectives are a key part of the terms of reference for your planning team or committee. The "Mount Allan Master Plan - Summary" suggests that they are the first step in the master planning process as they form the basis for program development and provide a measuring stick for the evaluation of alternative plans and programs.

1.04 Market Analysis and Needs Assessment

This should be the first step in the research section of the planning process. It is vitally important and should come before more time and expenditures have occurred. Results will show in general terms whether initially your project is viable.

In one sense the terms market analysis and needs assessment can be considered similar, however, there are some clear differences which should not be ignored. A market analysis should be done to evaluate the historic demand and supply relationships within the local and regional skier markets. This will establish the ski areas position as compared with current and planned ski areas. The market analysis can be used to assist with establishing design boundaries and to provide a basis for undertaking the necessary financial analysis of the project.

A series of demand (skier visits) and supply forecasts can be prepared using low, medium and high compound annual growth rates. This should provide the possible range of forecasted use for the new area. Market analysis tells you about your competition and general demand trends, it does not provide information on local preferences and site specific activity requirements.

Market analysis often deals with only the common market segment, i.e., downhill skiers, it does not tell you if different segments might be attracted to your ski area if other opportunities existed e.g., cross-country skiers to practice or experience telemarking.

An initial phase in facility planning is determining the needs and related services required for the particular activity or program. Input for this phase can often be obtained from local interest groups, various government authorities and recreation boards or associations which exist within the area to be served by the ski area.

There are several approaches to studying people's needs.*

1. What Do People Want?

   This type of needs assessment study focuses on finding out what people want or need. At the community level, the focus might be on what kind of programs different groups would like to see offered by a Recreation Department.

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* Based on "Enjoying Research? A 'How-To' Manual on Needs Assessment".

2. What Are People's Attitudes?

This type of needs assessment tries to measure people's opinions and attitudes. The research focuses on how people feel, not on what they want.

3. What Groups Need Services?

In this type of needs assessment research, the focus is on finding out which groups are not receiving the services they need.

4. Which Alternatives Will Be Most Relevant?

Deals with finding out which of several alternatives will be most effective.

Needs assessment research produces information about people's ideas, attitudes, and preferences. When we ask "Why collect this information?", we are asking about the purpose of the research activity. The purpose lies in how the information will be used.

The major purposes for gathering information about needs are:*

1. To Develop Long and Short Range Plans

In order to plan, organizations need to know about their client groups, the demand for programs, the feasibility of charging for service costs and alternative programs. Needs assessment research can potentially provide this information.

2. To Help Define and Solve Problems

Research methods can be used to identify and define problems. Sometimes problems are defined by studying records, observing operations, or by asking people directly. Other times when problems are already clearly defined, research methods are used to select different solutions.

3. To Help Decision Makers and Planners Set Priorities

Decision-makers and funders are often faced with having more plans than they can afford. To choose between programs that are necessary, and those that are good but not necessary, they need to know the extent of different community demands, and the impact of providing different programs. Needs-assessment research can help to provide this information.

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* From "Enjoying Research? A 'How-To' Manual on Needs Assessment".

4. To Prove You Know What You Are Doing

Needs assessment research can provide the background for accountability. The public and funding agencies want to know that your budgets were prepared based on realistic costs and that expenditures have been monitored. This is financial accountability. At a psychological level, you are also accountable to show that your plans have been carefully considered and related to the needs of those who will be served by those plans. Sometimes when changes occur in organizations, the staff does not know why. They wonder whether the changes are based on information or whim. Doing a needs assessment and reporting the results to those concerned can demonstrate your basis for planning.

5. To Surface Public Opinion

The previous four purposes of needs assessment research focus on how the information (the product or outcomes of your research) can be used. Research also has by-products: the very act of asking people for information can have an impact separate from the information itself. An organization can use different research methods not only to collect information but also to raise awareness and try to influence public opinion.

6. To Develop Community Support and Stimulate Action

Organizations can use specific needs assessment methods: (a) to find out what people want and (b) to involve them in taking action to get what the want.

For further information on needs assessment, especially participatory research, see "Enjoying Research? A 'How-To' Manual on Needs Assessment".

Market analysis even in conjunction with needs assessment does not automatically guarantee results nor even lead to correct decisions. For example a growing market is not necessarily a prerequisite for capital expenditure.*

The image and marketing of your area can have dramatic effects on its ultimate success (see section 4.04).

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* See "The Marketplace" in this work on p.164.

1.05 Choosing a Site

For many people this is the most exciting phase, however it should only be considered equal in importance to such elements as market analysis and needs assessment.

A number of sites should be selected based on initial needs, i.e., the results of Sections 1.03 and 1.04.

Alternative sites may of course depend on available land which may not be the best in the region. Table 1 presents a checklist which outlines the kind of information that is often available from existing sources and which can provide the necessary data for the assessment of physical characteristics.

TABLE 1
Sources of Information for Site Selection

- Maps:

  a) Municipal land ownership maps, land titles; available from municipal government offices and provincial land titles offices respectively.
  b) Access highway, country roads, seismic lines, trails, etc.; available from municipal government offices, planning commissions, Alberta Municipal Affairs, Alberta Transportation and Travel Alberta or Alberta Bureau of Surveying Mapping.
  c) Contour, topographic and other thematic maps including Canada Land Inventory (CLI) - preferably 0.6 m to 1.5 m (2' to 5') contour intervals; available from Alberta Bureau of Surveying and Mapping.
  d) Public services and utilities; electrical sources and lines, any nearby sewage disposal systems.

- Reports, Studies and Records:

  a) Climatic data:
     i) snowfall records
     ii) precipitation records
     iii) prevailing wind direction and velocity
     iv) sun angles and hours of sunshine; available from Environment Canada, Atmospheric Environment Service
  b) Ground water graphs and logs
  c) Soil studies and reports dealing with soil stability, erosion problems, environmental considerations and problems

- Photographs:

  a) Aerial photographs:
     i) mosaic
     ii) stereo pairs for each site
  b) Site photographs:
     i) summer
     ii) winter

The altitude, terrain, weather conditions and physical land form largely determines the way in which a ski area can be developed. One of the most important factors in determining the success of a ski area is that of climate. Without consistent adequate snow falls, or supplementary snow making equipment, a ski area cannot be successful.

The United States Forest Service (USFS) has a field inventory format to assist in the assessment of possible sites. The major elements listed are rated according to a set scale and in addition given a rating on the proposal.

Table 2 shows the field inventory format.

TABLE 2
Field Inventory Checklist

Location - Proximity to markets has a big influence on the success or otherwise of any ski field.

Area Available - For accommodation and ownership; for parking; and for ski terrain.

Access - Proximity of nearest road and standard of same.

Snow and Ice Cover - Estimated number of months; texture, dry or wet; depth; snowfall as an adverse factor, i.e., snow removal, operation of facilities, discomfort; period of statisfactory ice; if ice skating being considered.

Vertical Rise of Slopes.

Steepness of Slopes - Categorize percentage of slopes into novice 10% to 20%, intermediate 20% to 30%, advanced over 35%.

Aspect of Slopes - N, S, E or W.

Wind Conditions - Slight to frequent high winds.

Temperature - Above -18°C or generally below.

Avalanche Possibilities - No problems to site unsafe.

Slope Protection - Adequate or inadequate.

Cost of Slope Clearing - Low or high.

Ground Surface Conditions - Little or heavy work needed.

Availability of Power - If available; cost involved.

Parking Development Costs - Low to high.

Convenience of Parking Location - Walking, or transportation needs.

Appurtenant Service Development Possibilities - Adequate room for shelters, sanitation, water, etc.

Year-Long or Seasonal Recreation - Percentage of summer recreation.

Damage to Aesthetic View - Slope clearing visible from travel routes or population centres.

From such an assessment a site is rated outstanding, good, fair or unsuitable. If the preliminary assessment indicated the site is suitable for development more detailed planning starts.

SOURCE: "Ski Resort Planning and Development".

1.06 Multiple Use of Ski Areas

As mentioned in the introduction, one idea to create an economically feasible ski area might be to increase the scope of activities. This can be achieved in several ways. Extending operating hours to include midweek and/or night skiing and extending the season utilizing snow making equipment, are some options. Increasing the variety of activities both in winter and during other seasons can improve your area attractiveness and improve profitability.

A number of ski areas both large and small, in Alberta, have adopted many or all of the previous options. Even a small coffee shop in a trailer at a local ski hill can result in increased revenue and a more pleasant experience for the skier. The opportunity for both social interaction and a choice of activities can benefit both you and your customers.

For downhill skiers, a basic area need only include the slopes, tow facilities, adequate change and warming facilities. However, not everyone skis nor does everyone ski all the time, so alternative, outdoor activities could be provided.

With a winter season of five or six months, Albertans are participating in many winter outdoor recreation activities.

Table 3 illustrates numerous options to increase the scope of your activities:

TABLE 3
Selection of Additional Winter Ski Area Activities

ACTIVITY	PHYSICAL REQUIREMENTS
Ski Jumping and Nordic Combined	- consult with Alberta Division, Canadian Ski Association, Edmonton, Alberta.
Telemarking	- wide open downhill trails.
Snow Boarding	- ditto.
Tobogganing and Tubing	- 15%-49% slope.*
Luge (Naturbahn)	- beginner downhill slope, also consult with Alberta Sport Council.
Cross-Country Skiing (Nordic)	- cut trails and isolated open areas possibly track set and some illuminated. - incompatible with foot or downhill ski trails.
Biathalon	- groomed cross-country ski trails and target range. Also consult with Alberta Division, Canadian Ski Association.
Snow Play (general)	- adequate snowcover. - up to 30% slope.* - standard of .4 ha. (1 acre) developed slope per 60 people.
Snowshoeing	- snowcover, open area or trails.
Winter Hiking and Horseback Riding	- packed snow trail.
Snowmobiling	- well signed trails and isolated open areas, incompatible with foot or ski trails.
Skating	- flat, cleared area with flooding facilities, lake or pond. - temperature below 0°C.

* See also Figure 22, p.195 for slope percent calculations.

TABLE 3
Continued

ACTIVITY	PHYSICAL REQUIREMENTS
Broomball	- flat ice surface.
Curling	- can be indoor or outdoor. - flooding and pebbling facilities. - purchase of curling stones or manufacture of "jam can" curling stones.
Ice Fishing	- stocked lake, more than 3 m (10 ft) in depth.
Ice Racing	- lake frozen to thickness required to hold automobiles and/or motorcyles. - snow clearing equipment to clear area.
Ice Boardsailing and Ice Sailing	- lake frozen to thickness required to hold automobiles and/or motorcyles. - snow clearing equipment to clear area.

In addition, activities such as ski board-sailing, hang gliding (take off and landing on skis), heli-skiing, cat skiing, sledging and pulking (activities for the disabled) could be provided.

Ice/snow sculpting, winter camping and picnicking, nature interpretation, education/survival games, sleigh/hay rides, dog sledding, Christmas tree gathering, hot tubbing/saunas and carnivals/festivals are also suitable activities.

You may want to consider age segregated activity areas especially for tobogganning and tubing.

Age Segregated Tubing/Tobogganing Area

Drawing from Photo Courtesy of Clive Callaway

Snow trails adjacent to ski areas can be designed entirely by each developing authority or by a co-operative effort of various community and regional recreation related agencies.

The impact of trail development must be carefully examined having concerns similar to those of the downhill ski area.

Trails should take advantage of views and natural attractions in the area. A popular trail design is the loop. Rest areas and warm-up shelters could be provided at periodic intervals along the trails.

Snow trails should be located so that they avoid avalanche hazard areas, hazardous streams, and lake crossings (unless frozen completely), steep sidehills and established wildlife winter ranges. If trails must cross vehicle roadways, crossings should be marked for both trail users and drivers.

Table 4 shows the basic specifications and compatibility of trails within a ski area. For more detailed information on cross-country trails see "Cross-country Ski Trail Development", Alberta Recreation and Parks.

TABLE 4
Types of Trails, Specifications and Compatibility

TYPE	SPECIFICATION	COMPATIBILITY
Snowmobile	- Grade* - 6%-8% optimum. - 15% maximum sustained. - 25% maximum for short pitches	- Incompatible with non-motorized traffic.
	- 9 m (30 ft) maximum designed radius curve hard packed snow).	- Incompatible with residential area due to noise.
	- 18 m (60 ft) maximum designed radius curve (powder snow).	- Should be isolated.
	- 2.4 to 3 m (8 ft to 10 ft) minimum width.	
Ski Touring Trails Cross-Country Trails	- Grade* - 6%-8% optimum - maximum - 13%-14%.	- Compatible with other non-motorized uses if trails have similar specifications.
	- Variety of rolling and flat areas.	
	- 5-10 km (3-6 miles) long for family and day use.	
	- 2 m (6 ft) minimum width, wider on hills and approaches.	
Snowshoe Trails	- no specific grade or alignment. - should offer variety of terrain and view.	- Compatible with other non-motorized uses if trails have similar specifications.
Winter Hiking	- no specific grade or alignment. - packed snow.	- Compatible with other non-motorized uses if trails have similar specifications.

SOURCE: 1976 Edition "Ski Area Planning".

* See also Figure 22, p.195 for slope percent calculations.

To make the best use of a ski area, year-round activities should be considered. Unless other activities are tried or snowmaking equipment is installed, the facility can remain idle for over six months of the year. An alternative for off-season use is to lease the area to a group or agency for courses, seminars, workshops, conventions or a camp.

The other alternative is to operate your own spring, summer and fall programs. Development of a year-round family recreation area can increase revenue sometimes with very little increase in overhead. Table 5 illustrates the opportunities for year-round use of a ski area.

TABLE 5
Selection of Non-Winter Opportunities for a Ski Area

OFF-SEASON ACTIVITY	CORRESPONDING WINTER USE	PHYSICAL REQUIREMENTS AND ADJUSTMENTS
Hiking	- cross-country, winter hiking, snowmobiling	- can be more difficult terrain than winter equivalent
Horseback Riding	- cross-country, winter hiking, snowmobiling	- watch additional environmental impact on trails
Trail Bike Riding and All Terrain Vehicles	- snowmobile, downhill skiing	- care should be taken to eliminate environmental damage by motorized vehicles
Interpretive Trails	- cross-country, winter hiking	- adequate signing
Camping, Tenting	- natural areas	- level ground, service facilities
Trailer Court	- parking areas	- service facilities, level ground
Tourist Area	- chair lifts may be used for tourist shuttle service	- adjustment to lift facilities including reduced loading speed
Picnic Site	- natural wooded area	- some clearing - picnic tables, stoves, firepits
BMX Course	- possibly part of cross-country system	- requires special layout
Mountain Bike Trails	- some cross-country, winter hiking, snowmobiling trails	- good quality - compacted trails
Bike Trails	- cross-country, winter hiking, snowmobiling	- smooth, hard surface, adequate height clearance
Waterfront and Beach Activities	- skating, ice fishing, ice racing	- water area, sandy beach
Boating and Canoeing	- skating, ice fishing ice racing	- water area, dock area
Climbing and Mountaineering	- downhill ski slopes (as access corridor)	- steep grades, rock faces

In addition, day camps, outdoor education centres, water slides (which can also be enclosed for winter use), golf, tennis, sailing, hunting and carnivals/festivals could be considered as other activities.

For further information on the planning of other activities contact Alberta Recreation and Parks, Community Recreation Branch, Outdoor Recreation and Sport Facility Section and for physical requirements refer to "Planning for Recreation".

1.07 Feasibility Studies

The effectiveness of a feasibility study depends on the judgement and abilities of those who collect the data and of those who analyse it. The information collected in the preliminary planning process provides the basis for the feasibility report. This report contains recommendations and conclusions as to the proposed ski area, which are based upon:

- the market demand for skiing
- economic feasibility of the development
- the physical or environmental feasibility

The potential market for skiing is estimated by considering the total population of the region and calculating the percentage who are potential skiers. This percentage will vary with factors such as:

- the quality of the ski slopes; high quality slopes may attract more than the average market share and small slopes with little variety less then the average share
- access to the site
- distance to other ski areas
- the regional climate
- the age grouping of the population, a large percentage of young adults and children tends to increase the percentage of potential skiers

Any estimates of expected attendance and lift ticket sales at a ski area should be conservative with numbers being under-estimated rather than over-estimated.

Economic feasibility is calculated in terms of the total capital and operational costs of a ski area. Data collected should outline:

- initial financial requirements
- projected revenue of the development
- estimated operations and maintenance costs, including management

The physical feasibility study of a ski area determines whether a site meets the minimum requirement for your ski hill and whether or not the development on a given site would be environmentally harmful.

If you are considering expansion at an existing area, you should refer to "Criteria For Ski Area Expansion" by Ted Farwell.

Another important reference for new or expansion projects is the article entitled, "The Appraisal of Ski Areas". This article divides a ski area appraisal into six critical steps:

1. Physical Site Evaluation
2. Ski Area Economic Characteristics
3. The Skier Market
4. Competition
5. The Skier - Visit Forecast
6. The Valuation

This exercise becomes essentially a feasibility review in itself.

1.08 The Concept Plan

Now you should be ready to prepare a concept plan. A summary of ideas and research data from which a design can be prepared for preliminary development approvals (e.g., preliminary disclosure if on Crown land), financial backers and public relations. Such a plan can also be costed and appraised for ultimate value. The "Commercial Alpine Skiing Policy Section 3.4.0200" (B.C.) which is endorsed by the CWSAA, provides a good checklist of "conceptual proposal components".

"... 1.1 Components

Project Viability in Broad Terms

(a) Define the project. The first phase of development should be described in finite terms while the long term program may be conceptual.

(b) Quantify physical characteristics of development area; including:
   i) Terrain analysis-market profile;
   ii) Weather data;
   iii) Water availablility;
   iv) Waste water management; and
   v) Other.

1.2 Operating Plans for the Project

(a) Estimate total cost for the project.

(b) Research market and identify segment to be attracted.

(c) Identify plans to offset impacts on environment, resources and resource users.

(d) Identify and quantify secondary benefits.

(e) Quantify employment created.

(f) Analyze project for risk.

1.3 Management Competence and Ability

(a) Define present management structure.

(b) Describe expanded or altered structure which will accommodate project.

(c) Provide key executive profiles highlighting expertise and achievements.

(d) Name key advisory support, specifically financial and legal services and technical experts.

(e) Provide evidence of corporate and/or personal citizenship.

1.4 Financial Ability

(a) Provide current financial statements signed by two directors.

(b) Where such financial statements are not audited the Province may require that a proponent supply audited statements. Where the financial statements of the proponent company do not clearly demonstrate the financial ability to undertake the project or where the proponent is an individual or a group of individuals or where personal guarantees are used, submit a personal net worth statement of applicant and/or controlling shareholders. Establish the value for investments in the applicant corporation at cost.

(c) Supply evidence of external financing commitments in place, if any.

(d) Supply letters of consent addressed to bankers, advisors and investors, permitting the addressees to disclose the affairs of the applicant and its principals to Ministry appointed officials to the extent that such disclosure is related to the proposal.

(e) Other information as may be required by the Ministry, or other Ministries..."

Figure 1 provides an example of a ski area concept plan.

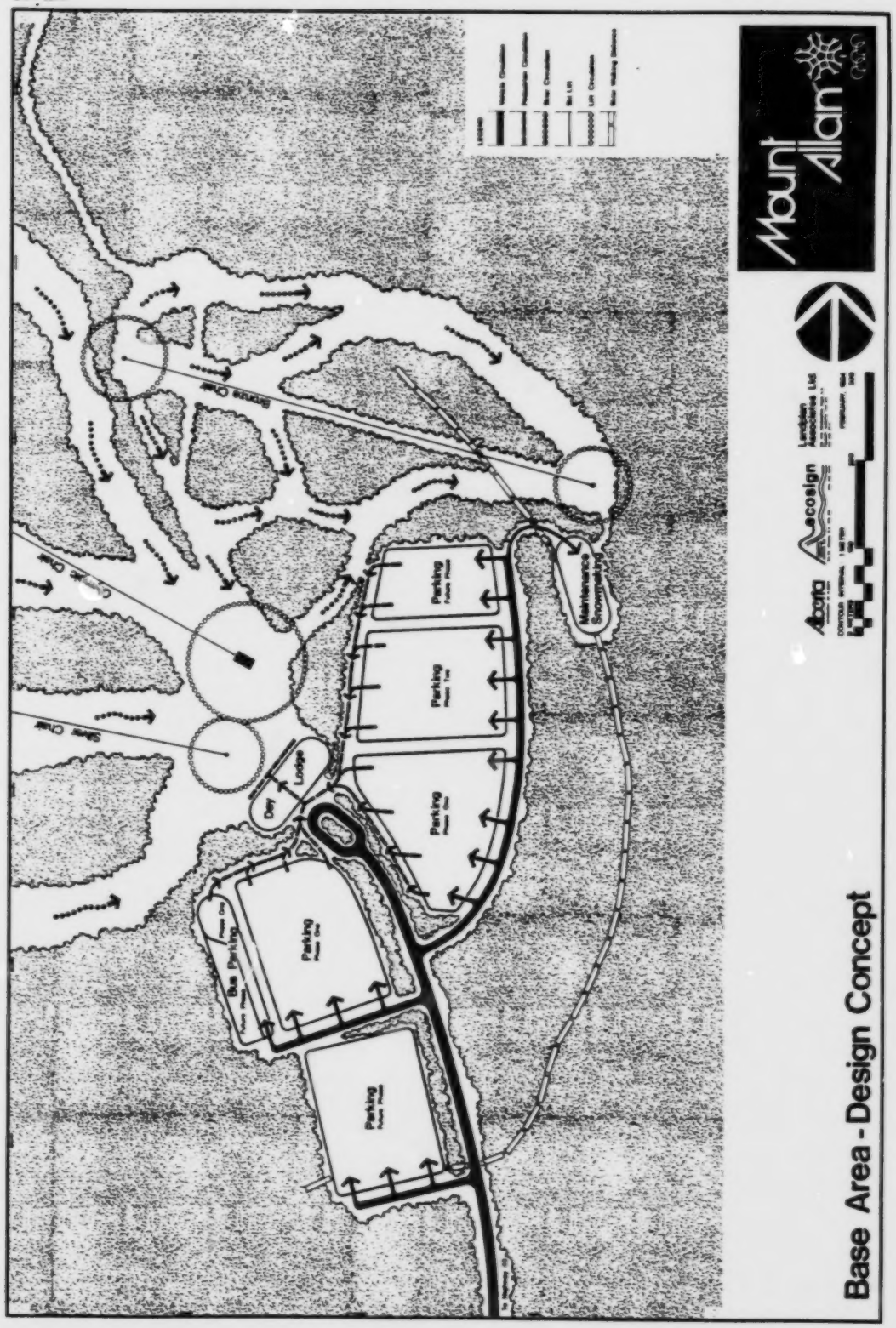

FIGURE 1
Ski Area Concept Plan Example

1.09 Potential Concerns

Policy and public issues should be identified prior to and during the planning process by way of public input, on-site investigations and preliminary design considerations. Major issues usually relate to:

- climate
- environmental quality
- phase and base area design boundaries and concepts
- site access and infrastructure

Many of the issues raised by the planning team and/or professionals together with statements of public concern can be considered and incorporated into the Master Plan where applicable and feasible. Using a combination of documented information and on-site investigations, the planning team can generate design options and associated costs, benefits and potential implications for consideration. The combined expertise of the planning team and professionals possessing ski area planning and development experience can then be utilized to identify the optimum solution based upon operational efficiency, cost and the maintenance of environmental quality.*

Table 6 provides a checklist of typical concerns.

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* Derived from "Mount Allan Master Plan - Summary".

TABLE 6
Potential Concerns Checklist

A. Environmental Conerns

1. Resource availability (water, minerals, grass, timber, wildlife, etc.)
2. Impacts upon wildlife.
3. Solid waste and disposal.
4. Sewage disposal from the project.
5. County/Town water supply - (ability to filter contaminants, surface water control).
6. Creek water level and quality.
7. Creek valley air quality.
8. Maintenance of visual quality.
9. Availability of energy.
10. Surface water runoff:
    a) Total impact on stream (in addition to County/Town water supply).
    b) Erosion control during construction years.

B. Economic Concerns

1. What is the area of impact of the project.
2. Community public services and facilities, additional needs for County/Towns and special districts.
3. Method of financing the additional public facility and service needs of jurisdictions identified.
4. Financial ability of governmental agencies to support the additional public services and facilities resulting from growth.
5. Financial ability of proponent to complete and maintain development.
6. Road and related capital improvement in the area.
7. Additional highway maintenance needed.
8. Traffic volume increase in region.
9. Utility needs for the project.
10. Utility facilities leading to the project.
11. Economic effects upon outdoor recreation, including consumptive and non-consumptive uses.
12. Effects upon present population, employment and income levels.
13. General indication of demand and need for skiing.
14. Housing availability for current residents.
15. Effects of tax changes on the individual.
16. Effects upon existing industry.
17. Spin-off industries which might contribute to Town's economic position (i.e., ski clothing factory, ski manufacturer):
    a) Will there be any.
    b) What kinds of impacts to County/Town might they present.

C. Social and Cultural Concerns

1. Recreation of local area, state and nation.
2. General demand and need for other competing uses.
3. Effects upon citizens and property in the area.
4. Effects upon schools, parks and other public facilities and services.
5. Need for health care facilities (hospital, emergency, clinic).
6. Housing availability for current residents and project employees.
7. Effects upon job types and availability.
8. Life style changes.
9. Maintenance of cultural integrity.
10. Construction traffic volume increases.
11. Impacts of construction and other temporary workers on area.
12. Effects of growth on secondary impact area.

D. Land Use Concerns

1. Capability and suitability of proposed area for skiing.
2. Identify possible alternate land uses for the mountain area.
3. Conceptual plan of proposed winter sports site.
4. Additional county airport improvements needed.
5. Water rights for the project and others.
6. Expected number of beds and support people needed for the project.
7. Area that could be expected to develop if a Forest Service permit is issued for proposed winter sports site.
8. Area that could be expected to be impacted by the project.
9. Timing and co-ordination with other developments.
10. Capacity limits of local area for development.
11. Ability of local area to accept (for services, housing, etc.) a winter sports site.
12. Potential, planned, and existing winter sports sites nearby.
13. Changes in land use in the local area.
14. Changes in land use activities on public lands.
15. Cumulative effects of winter sports sites in the River Valley.

E. General Concerns

1. Ensure adequate public involvement.
2. Relate project to existing federal, state (provincial), regional and local plans.
3. Cumulative effects of winter sports sites.
4. Effect upon valley and adjoining communities.
5. Ability of affected governmental agencies to respond to proposal.
6. Alternative transportation modes (including air, rail).
7. Mass transportation need of state (province) and region.

SOURCE: USFS "Winter Sports Complex Planning".

1.10 Methods of Financing

A written document, explaining the intentions of the proposed develoment, called a prospectus, could be prepared for submission to funding agencies. This prospectus should include:*

- An analysis for the proposed location and site.
- Advantages and disadvantages for the intended use.
- Proposed layout of all development, including buildings, water supply, waste disposal, play areas, signs and waterfront development.
- Proposed building plans; at least rough floor plans and suggested exteriors with some notes about specifications.
- Estimated costs of building construction, equipment, furnishing, and all site development - all the costs to get the business started.
- A business plan - an estimate of fixed costs, operating costs, possible income and return on the investment.
- Personal qualification of the owners or managers; justification for the establishment of business.

Essentially the prospectus informs of the history, objectives, capability and capacity of the owner and/or operator, its management and investors. For further information see "Ski Area Financing".

Grants, subsidies and loans are available from a variety of sources. Sometimes they are restricted to studies, professionally prepared concept and/or master plans and design fees, the provision of infrastructure and facilities or operational expenses.

Table 7 presents a selection of sources of potential funds.

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* See Motels and Resorts: A Guide to Better Planning.

TABLE 7
Potential Funding Sources

- Banks, trust companies, Treasury Branches
- Alberta Opportunity Company
- Share issue
- Personal debentures
- Casinos, lotteries (if registered as a non-profit society)
- Donations
- Federal/provincial DRIE sub-agreements
- Community Recreation/Cultural Grant Program (Alberta Government)
- Recreation Areas Program (Alberta Government)
- Trail Development (Alberta Government)
- Recreation, Parks and Wildlife Foundation (of Alberta)
- Other private foundations
- Various employment subsidy programs, for example:
  - Alberta Environment Employment Program
  - Alberta Wage Subsidy Program
  - Summer Temporary Employment Program (S.T.E.P.)
  - Priority Employment Program (P.E.P.)
  - Various other Alberta Employment and Training Programs and Employment and Immigration Canada Career Access Programs.
- Alberta Forest Service (if in Green Zone)
- Volunteer labour
- Local municipality appropriation
- Joint venture partnerships
- Operating lease

CHAPTER II

THE MASTER PLAN

2.01 What is a Master Plan?

A ski area master plan usually means a detailed description of the planned development defining in detail the location of all major elements of the ski hill together with an assessment of the ecological and socio-economic impact on the area in general.*

A master plan is the first step in the site development process. Opportunities and problems are identified and the process focuses upon design to resolve issues and concerns in meeting final objectives. The Master Plan is a tool to guide development and does not dismiss the requirements for detailed design, engineering and architecture prior to on-site construction activities. As the ski area development proceeds through the detailed design and field layout stages minor changes to the Master Plan in terms of the site-specific placement of buildings, lifts, ski trails and utilities may occur within the development area boundaries. The Ski Area Master Plan, represents the integration of a variety of physical, ecological, financial and market considerations into a design ensemble of interrelated facilities and activities.**

A Physical Site Analysis is required as part of the master planning process. It is an evaluation of the physical potential of the development which should contain the following elements and can be highlighted in map format:***

Identifiable Elements:

- ownership and surrounding uses
- existing features
- survey base line and control points
- topographic slope evaluation
- bedrock geologic hazards
- hydrological characteristics
- vegetation
- soils
- wildlife
- topographic orientation
- sun/shadow
- visual quality
- walking distance
- skiing
- development and suitability map, highlighting areas of restricted growth potential

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* Derived From "Commercial Alpine Skiing Policy Section 3.4.0200".

** Derived from "Mount Allan Master Plan - Summary".

*** Based on "Commercial Alpine Skiing Policy Section 3.4.0200".

Climate both general (macro) and local (micro) should be considered also. The physical site analysis is essentially an inventory of existing conditions studied specifically with skiing and the skiers and non-skiers experience in mind.

The Master Plan forms an integral part of a formal proposal and is a critical part of any evaluation and approval process. It:*

- provides review agencies with the information necessary for their understanding of the project
- provides documentation of the existing site features that influenced project planning
- provides a guide for the long term development
- defines scope of detailed economics, site and engineering design
- integrates the planning with any government policies

The Master Plan supplies evidence that the objectives and regulations of relevant governing bodies will be satisfied, specifically with respect to:*

- physical site analysis
- slope analysis
- avalanche assessment and safety program
- ski potential evaluation
- lift and trail location, configuration and sequence
- base site evaluation, design concept and sequence
- ski area facility capacity review including snowmaking bed unit adjustment
- environmental study and assessment
- access, parking and circulation
- infrastructure design concept
- resource conflict evaluation
- base area equipment requirements
- snow-making equipment requirements
- non-alpine winter sports activities - definition and location

Examples of ski area master planning documents which are accessible to the general public are:

- "Mount Allan Ski Area Master Plan", 1984
- "Cypress Hills Ski Facilities Study", 1981

Figure 2 shows the process used for the Mount Allan Master Plan.

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* Derived from "Commerical Alpine Skiing Policy Section 3.4.0200".

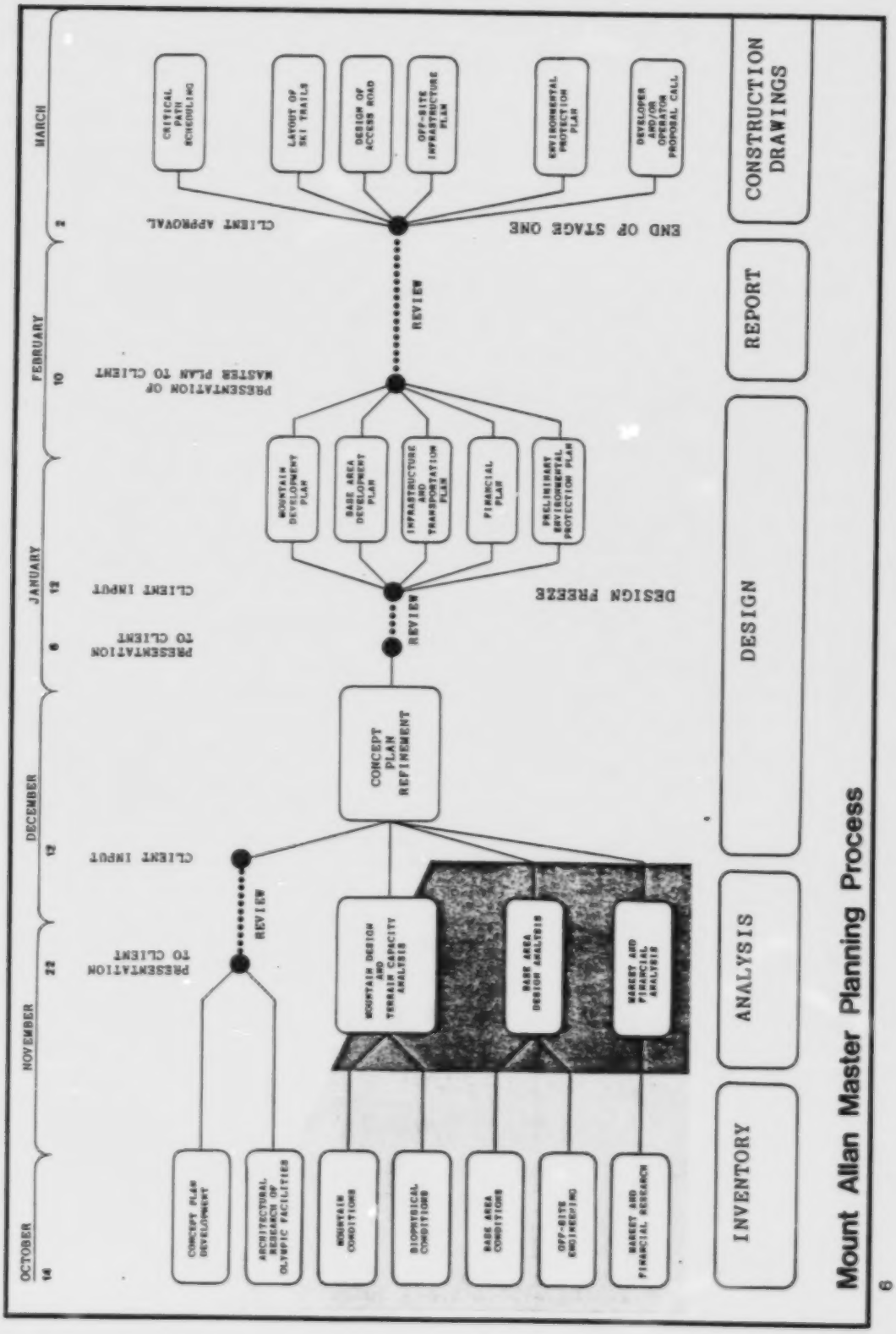

FIGURE 2
Mount Allan Master Planning Process

2.02 Master Planning on a Small Budget

If hiring an experienced ski area planning consultant to prepare your master plan cannot be justified, you may wish to prepare your own. For very small local ski hill operators this may be the only option available. Some experienced consultants may be willing to act in a limited capacity to advise you or even to review your plans. This expenditure should be considered as a minimum investment.

There are a number of things that you can do to reduce your planning costs. Remember, however, you get only what you pay for. Carl Reynolds, in a presentation to a ski area planning symposium, has the following ideas list for small, new or old (expanding) areas which may help you towards a master plan.*

What You Can Do on a Small Budget

1. Know Your Area ("know thyself"):
   If you have lived with the area for a number of years, you probably already know the area better than anyone else (in many ways).

   If it is a new area, take plenty of time.
   Watch out for over-confidence. We lovers of skiing can easily fool ourselves - about weather, snow conditions, feasibility, economics, etc.

2. Collect Statistics:

On snow depths	at base along proposed lift lines	
On weather	temperature wind cloud cover	
On car counts	highway traffic parking area out of province bus	
On ticket sales	skier visits ski school season pass night skiing	package program freebee prices
On finances	different departments income per skier	

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* From "Master Planning With a Small Budget".

3. Make a Collection of Photos - Both Color and Black and White:

Record what you have done in the past.
Before and after photos.
Terrain for future use and development.
Aerial photos - both summer and winter.
Photos of other areas to record ideas.
- Architecture
- Signs
- Landscaping
- Lift construction and details
- Parking - equipment

4. Get the Best Maps Possible:

Search out all existing maps: AFS, Geological, soil, local bodies such as sanitary district, if any.
Making (having made) your map:
- on the ground
- aerial survey

Use of stereo pairs.
Blow up of vertical photos.

5. Use of Maps:

Basic master planning layout.
Overlays.
Aids to mapping and charting - chart pads, etc.
Detail maps of critical areas - base area, mountain top.

6. Make a Model of the Ski Area:

Value of making your own model.
Professional models.

7. Get the Thinking of as Many Other People as Possible:

Your ski school personnel.
Your ski patrol.
Your skiing public.
State (Provincial), Federal, Local authorities.
Your peers - Trade association members (no area too small or remote to benefit from this).
Visit as many other areas as possible.
Get to know as many other area operators as possible.
Architects.
Consultants.
Financial advisors - bankers, accountants.

8. Organizing and Presenting Your Master Plan:

To whom is it addressed?
- yourself
- your stockholders
- your bank
- the county or state (province)
- the "environmentalists"
- the public

Importance of visual material:
- statistical data - charts and graphs
- photos
- maps
- format - how many copies?
- preparing material for printer

9. Revision of Master Plan:

Plan should remain flexible.
Identify alternatives.
Provide room for changing conditions and future possibilities.

10. What does the future hold?
(Anyone can play this game! Be well read.)

Population growth.
Energy and resource limits.
Standard of living - will it go up or down.
Carrying capacity.
Recreation's place in the future.

2.03 Ski Area Capacity

"The determination of an area's Skier Carrying Capacity (SCC) is perhaps the most critical step in ski area planning. This calculation represents the number of skiers per day which can be safely supported by an area's lift and trail systems while providing a quality experience to each skier ability level. SCC is determined using lift capacity, acceptable slope densities, slope gradients, skier skill classifications and vertical metres of lift-serviced terrain. Surveys conducted reveal that Albertans possess skier skill levels which closely approximate the bell curve distribution found in the general North American skier market. ... It should also be noted that machine snow is considered to be more durable than natural snow and therefore can sustain higher skier densities, with less wear and tear on the slopes ...

... The capacity of the ski area must be determined before visitor services, accommodation, uphill facilities and food facilities may be studied. In most cases, the area capacity is determined by the maximum slope capacity of the ski terrain available, assuming reasonable skier densities per acre of skiable terrain."*

"(a) Skiers consider capacity as the point where the number of skiers interferes with the amount of vertical metres (feet) which they can ski in a given day.

1. There is a maximum number of skiers that can be accommodated within the area.
2. There is a sociological capacity above which user satisfaction drops rapidly.
3. There is a design or planned capacity, although design capacity usually refers to individual facilities such as lifts, parking, etc.
4. There is a physical or ecological capacity above which additional numbers of skiers will result in unacceptable damage to the environment. Therefore, the maximum capacity of a ski area is reached when a factor or a combination of factors precludes accommodating more skiers.

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* From "Mount Allan Master Plan - Summary".

(b) The sociological or "normal" capacity is the capacity at or below which most skiers will still have a satisfactory experience. This normal capacity will vary by the type of clientele. Skiers at a metropolitan ski school will accept more crowding than vacationing powder skiers.

(c) Lift capacity and area of ski slopes are the primary parameters for determining an area's skier capacity (i.e., the SCC).

Based on the above statements, the design capacity of a ski area can be determined for the present development and future development by analysing, both in quality and quantity, slope capacity, uphill facilities capacity skier circulation, density of parking, shuttle bus transportation, restaurant and rest room facilities on the mountain, and in any adjacent village area.

Other factors that can impose problems to capacity are: access road capacity; parking area capacity; water capacity; and airport capacity.

Terrain capacity calculations include an allowance for skiers on the slopes, riding the lifts, standing in lift lines, and resting in facilities. All researchers agree that acceptable densities decrease as skill levels and speeds increase.

Another consideration given to lift queue time is that perhaps it could be related to the uphill ride time (i.e., short rides, short waiting times and the reverse). However, most authorities base acceptability on a 10 to 15 minute queue time."*

In summary, a determination of the number of skiers the facility will accommodate when considering all the limiting factors, including the Comfortable Carrying Capacity, is called the Mountain Design Capacity.

Such factors will address physical and support facilities and may include road access, parking, maintenance, snow making and other concerns which will impact on safety and comfort.

Mountain Design Capacity will determine the allowable boundaries for development of the ski facilities.

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* From "Ski Resort Planning and Development".

2.04 Climate

Climatic conditions are extremely important to the operation and viability of a recreational ski area.

The primary focus of the climate studies in the master plan study is to assist with the planning, design and operation of the ski area. For example solar analysis assists with the location and orientation of buildings so as to maximize the benefits of the sun. At the same time it is used to analyze the potential for shading on the runs during different times of the day. Winds are addressed in light of the lift locations, the effect of tree clearing on wind factors and the possible need for changes to correct any negative effects of the winds. In addition snow accumulation is mapped to assist with designing the specifications for a snow making system. Temperature and humidity are also examined for snow making and general comfort considerations. Finally, avalanche hazards are assessed as these represent a possible development problem and/or an operational consideration.

Alberta's climate during the winter is generally very cold and dry. The extreme cold does result in considerable snow retention in the northern half of the province. Snowfall is also relatively heavy in the mountains and foothills on the western boundary. Temperatures throughout the winter usually remain well below freezing except for the occasional chinook winds experienced in Southern Alberta.

A brief analysis of the regional climate will suggest the more appropriate sites during preliminary planning, however, a detailed (local) micro-climatic analysis of a site is required to determine:

- the feasibility of operating without snow making equipment
- the length of the ski season
- the optimum capacity of the site
- the aspect and location of slopes
- the location of fences, buildings, roads and lift equipment

Information on the micro-climate of a specific site can be obtained from the Atmospheric Environment Service of Environment Canada and the local meteorological station.

Those aspects of the micro-climate specifically affecting ski area planning are the snow and rainfall, snow conditions and the winds including chill factors, drifting and chinooks. The data collected for the site in question should be obtained for several years in order to evaluate trends.

Alberta has a number of regions where snowfall levels vary from heavy in the mountains and foothills on the western boundary and in the northern two-thirds of the province, to almost none in southern Alberta near Lethbridge and Medicine Hat. Adequate snow cover for skiing lasts from December to March, over most of the province.

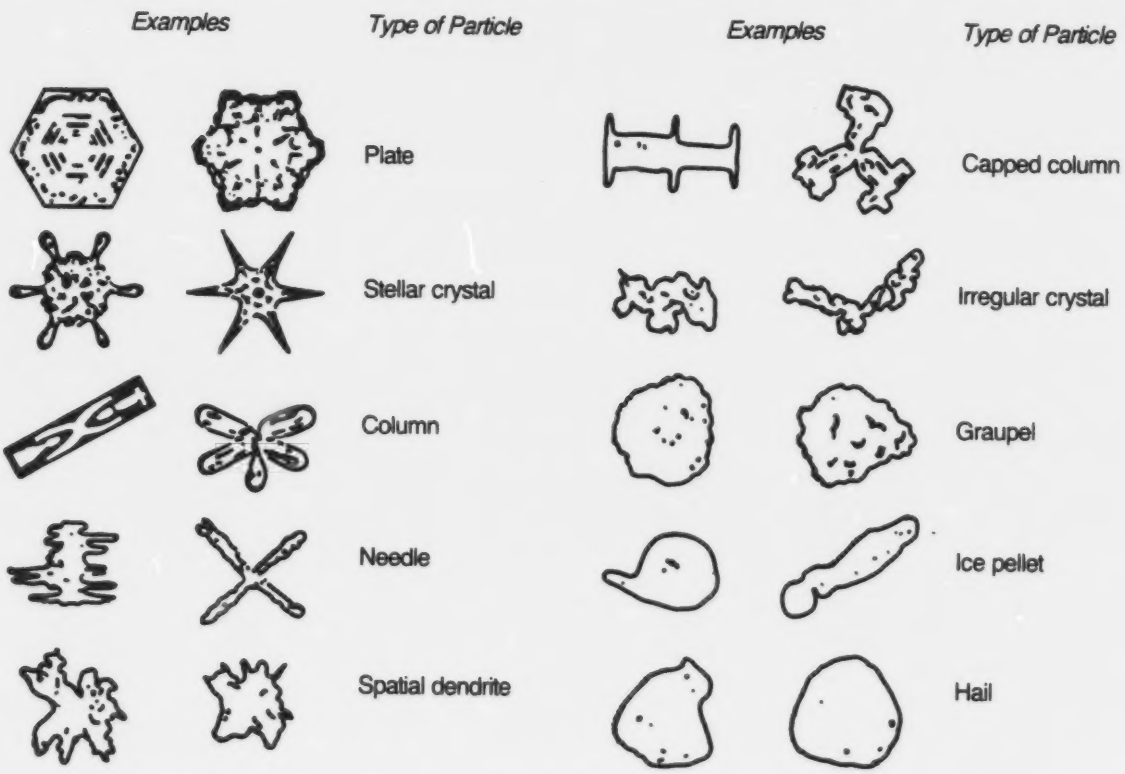
Snow conditions at a ski area will establish the attractiveness of the area. These conditions are determined by a combination of the type of snow falling and the effects of sun, temperature, winds and skier traffic on the fallen snow.

Heavy solid snow particles such as graupel, ice pellets or hail will compact and give a much more packed condition. Light fresh fallen snow particles such as stellar crystals, plate or column will give light powdery conditions (see Figure 3). The more compact the cover is, the more able it is to withstand heavy use. Warm temperatures followed by a cool spell will produce corn snow conditions.

FIGURE 3

Types of Particles of Falling Snow

International Snow Classification for Solid, Falling Precipitation



Snow conditions will usually begin to decline at temperatures above -7°C in the sun. Both the hours of sunshine and the sun angle have a bearing on the decline of conditions (see Tables 8 and 9, and Figure 4).

TABLE 8
Average Monthly Hours of Bright Sunshine
1951 - 1980

	JANUARY	FEBRUARY	MARCH	APRIL
Banff	55.5	98.0	133.8	154.4
Beaverlodge CDA	74.4	108.7	160.2	209.0
Brooks AHRC	88.4	116.5	158.2	205.8
Calgary INTLA	102.0	127.9	162.2	204.9
Cold Lake A	90.8	125.2	171.8	228.2
Coronation A	119.0	133.2	183.4	231.2
Edmonton INTLA	97.7	118.5	172.1	232.8
Edmonton Municipality	90.0	116.3	167.5	228.3
Edson A	83.0	116.3	153.9	204.3
Ellerslie	91.0	121.6	165.1	227.8
Fairview	68.6	108.2	160.6	225.5
Fort McMurray A	88.2	129.3	165.1	231.6
Fort Vermilion CDA	69.8	109.9	174.6	235.0
High Level A	54.0	125.5	175.0	246.4
Kananaskis	63.0	112.3	162.8	186.7
Keg River	61.5	95.9	138.6	195.9
Lacombe CDA	87.5	115.0	162.2	198.3
Lethbridge CDA	95.3	122.9	166.8	197.9
Manyberries CDA	89.3	114.3	162.2	194.4
Medicine Hat A	93.0	122.2	162.2	200.9
Olds	86.2	118.4	156.0	191.6
Ranfurly	87.7	117.8	168.5	222.9
Slave Lake A	83.8	113.5	167.8	233.2
Suffield A	98.1	126.0	179.9	209.7
Vauxhall CDA	99.2	122.4	163.2	197.2

SOURCE: Canadian Climate Normals - Volume 7 - Bright Sunshine Environment Canada.

TABLE 9

Sun Angle at Noon Above South Horizon

	LATITUDE											
DATE	49	50	51	52	53	54	55	56	57	58	59	60
Dec. 21	17 1/2	16 1/2	15 1/2	14 1/2	13 1/2	12 1/2	11 /12	10 1/2	9 1/2	8 1/2	7 1/2	6 1/2
Jan. 21*	25 1/3	24 1/3	23 1/3	22 1/3	21 1/3	20 1/3	19 1/3	18 1/3	17 1/3	16 1/3	15 1/3	14 1/3
Feb. 21	33 1/3	32 1/3	31 1/3	30 1/3	29 1/3	28 1/3	27 1/3	26 1/3	25 1/3	24 1/3	23 1/3	22 1/3
Mar. 21	41	40	39	38	37	36	35	34	33	32	31	30
Apr. 21	48 2/3	47 2/3	46 2/3	45 2/3	44 2/3	43 2/3	42 2/3	41 2/3	40 2/3	39 2/3	38 2/3	27 2/3

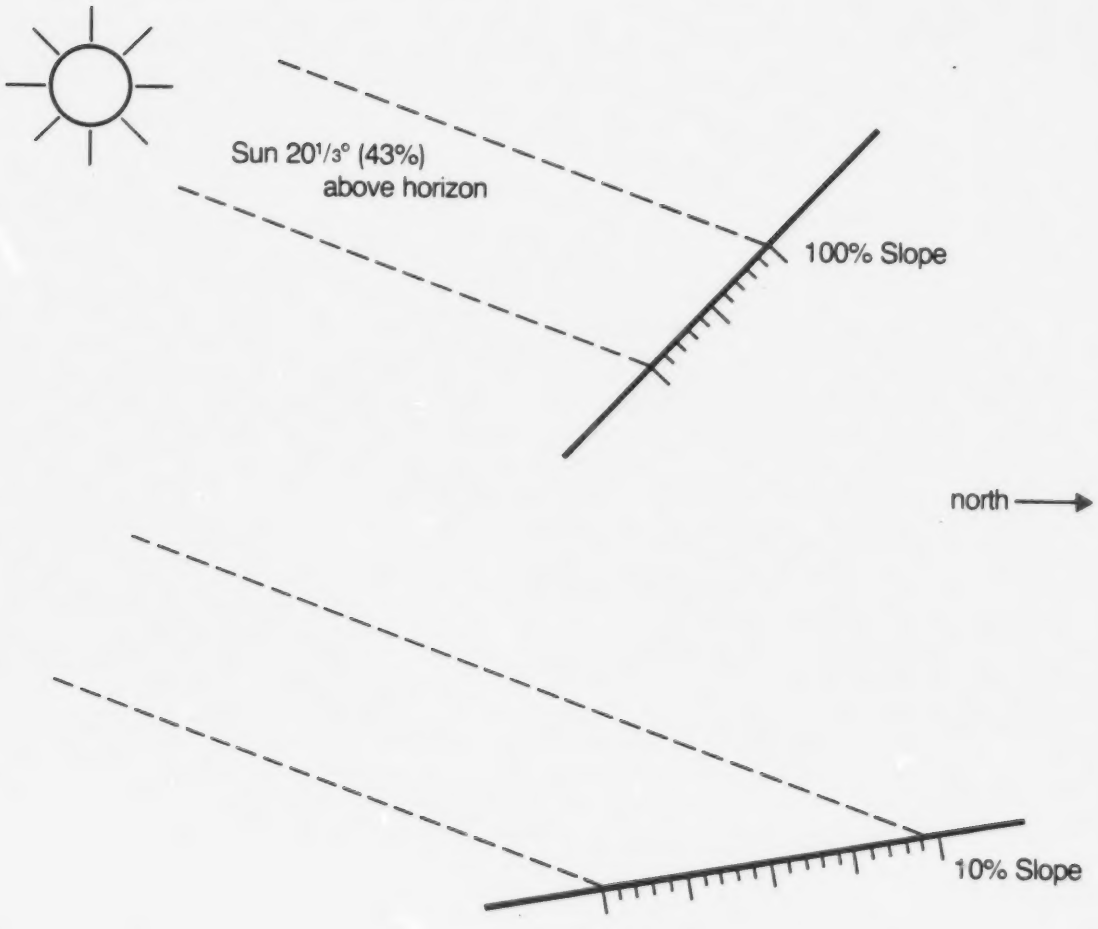
* Nov. 21 - sun angles are the same as Jan. 21.

SOURCE: 1976 Edition "Ski Area Planning".

FIGURE 4

Effects of Sun Angle on Different Gradients of Ski Runs

Sun at Noon - either Nov. 21 or Jan. 21 at 54° N



Winds and wind velocity will influence ski area planning. The major factors relevant to ski area design are:

- snow drifting and wind blown areas
- wind chill
- chinook winds

In Alberta the most dominant high velocity winds are the "Westerlies". These blow from the west, northwest, or southwest, depending on locale. East of the foothills occasional high velocity southeast winds have been experienced.

Drifting is basically a result of these high winds and local landforms. Excessive drifting can be reduced by carefully located fencing. Some engineering firms have specialized in snowdrift control.

The wind chill factor is really the heat loss of the human body due to the cooling effect of the wind. Appendix E shows the temperatures and winds with equivalent wind chill temperatures.

Chinook winds are basically those which precede a warm front moving into Alberta. These winds usually blow through the Southern Alberta mountain passes from the West Coast, i.e., Roger's Pass and Crowsnest Pass. The warm, dry chinooks can ruin snow conditions if they persist for more than a day. The areas most affected by chinooks are around Calgary, Lethbridge and Pincher Creek. Ski areas at higher altitudes, above 1,500 m (5,000 ft ±), are less affected by the chinooks. Also, areas north of Red Deer can be free from chinooks. Historical records for each particular area should show the frequency of chinook winds.

2.05 Environmental Impact

A ski area can have a major impact on the environment if not planned, designed, built and operated with care. During the master planning process some kind of environmental inventory is usually undertaken.

In parklands and undeveloped areas wildlife habitats and behaviour patterns are studied and the results mapped. The results of these studies are used in the preparation of programs, design, implementation strategies and operational and management plans for the ski area. The area should be designed so as to eliminate and/or minimize any potential negative impacts on the wildlife populations.

Fisheries, vegetation and historical/archeological resources are studied to determine whether significant resources exist which should be preserved. Also, these resources are viewed in light of whether they offer opportunities which could enhance the site program.

Visual resources are considered to maximize the positive, and in some respects outstanding views from different points at the site, as well as to minimize the negative views from access roads and from within the site area.

The subject of the visual resource is highly relevant to a ski area due to the open ski slopes and lift/tow lines.

The reader is advised to consult an excellent publication entitled "National Forest Landscape Management Ski Areas, Volume 2, Chapter 7". Computer technology is available to simulate the location of runs and lines and illustrate the visual impact.

Minimizing the visual impact will usually reduce the overall impact on the environment.

The hydrology of the area should be examined, primarily to determine the effect of clearing, on the watershed, as well as the potential impact of snowmaking and the resultant snowmelt/runoff conditions. Potentially high sediment yields can occur as a result of road construction and logging.

2.06 Terrain Analysis

The majority of the following comments have been derived from the "Mount Allan Master Plan - Summary" and illustrate the current state of the art of ski area terrain analysis.

The quality and feasibility of a winter sports site is highly dependent upon the topographic characteristics of each individual site. Physiographic features which substantially affect ski development include aspect (exposure), slope gradients, fall line patterns and elevation. Each of these features should be investigated in detail.

Biophysical considerations relate not so much to the physical capacity of the site to be developed, but more toward the suitability of the site for development. Surficial geology and soils studies should be conducted mainly to determine the construction suitability of different components of the project, and to identify areas unsuitable for development, mostly from a cost standpoint.

A soils report should be prepared during the detailed analysis of the site. This soils report is developed from the soils inventories and profile of the top 1.5 m $\pm$ (5 feet) of crust. The report includes:

- Soil profile map - extent and distribution of different soils
- Technical descriptions - physical and chemical characteristics, and the environmental influence of climate, geology, topography and vegetation

The data contained in the soil reports, inventory and profile would be interpreted to determine:

- Mass movement potential of the surface and underlying soils
- Erosion potential of surface soils if protective cover is disturbed
- Limitations of maintaining and re-establishing vegetation
- Soil drainage characteristics
- Soil limitation for:
  - road location and construction
  - low building foundations
  - sewage disposal
  - ski slope design

The purpose of a site development analysis is to blend the information and/or problems identified during the inventory stages with acceptable ski industry planning boundaries for both the ski slopes and base area. Specifically, the constraints imposed by climate (natural snowpacks, winds), wildlife (habitat and movement corridors), surficial geology (depth to bedrock, potential hazards, high water table) and vegetation (tree species and heights), serve to define the limits for development and determine the design modifications necessary to meet the site specific needs of Alberta skiers.

Two analyses should be undertaken to assist with ski area design and provide an added basis for the evaluation process. A Fall-Line Analysis Map (refer to Figure 5) should be prepared which outlines major drainages, fall-line patterns and primary and secondary fall-line concentration areas. The primary concentration areas suggest potential lift terminal locations and hence suitable base facility locations. Secondary concentration areas suggest trail connection points. A Ski Area Slope Analysis Map can be prepared which outlines the areas that can be negotiated by the various skier ability levels as well as the areas which are too flat or too steep for the skiing public. The natural slope gradients should be measured and coded according to the following classification:

Slope Gradients*	Type of Skiing
0% - 8%	flats, marginal skiing
8% - 25%**	beginner and novice skiing
25% - 45%	intermediate skiing
45% - 70%	advanced and expert skiing
70% **	unskiable, safety zones

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* See also Figure 22, p.195 for slope percent calculations.

** Some consultants/skiers, etc., feel that 80% is upper level for experts and that 20% is upper level for beginners (see Section 3.02).

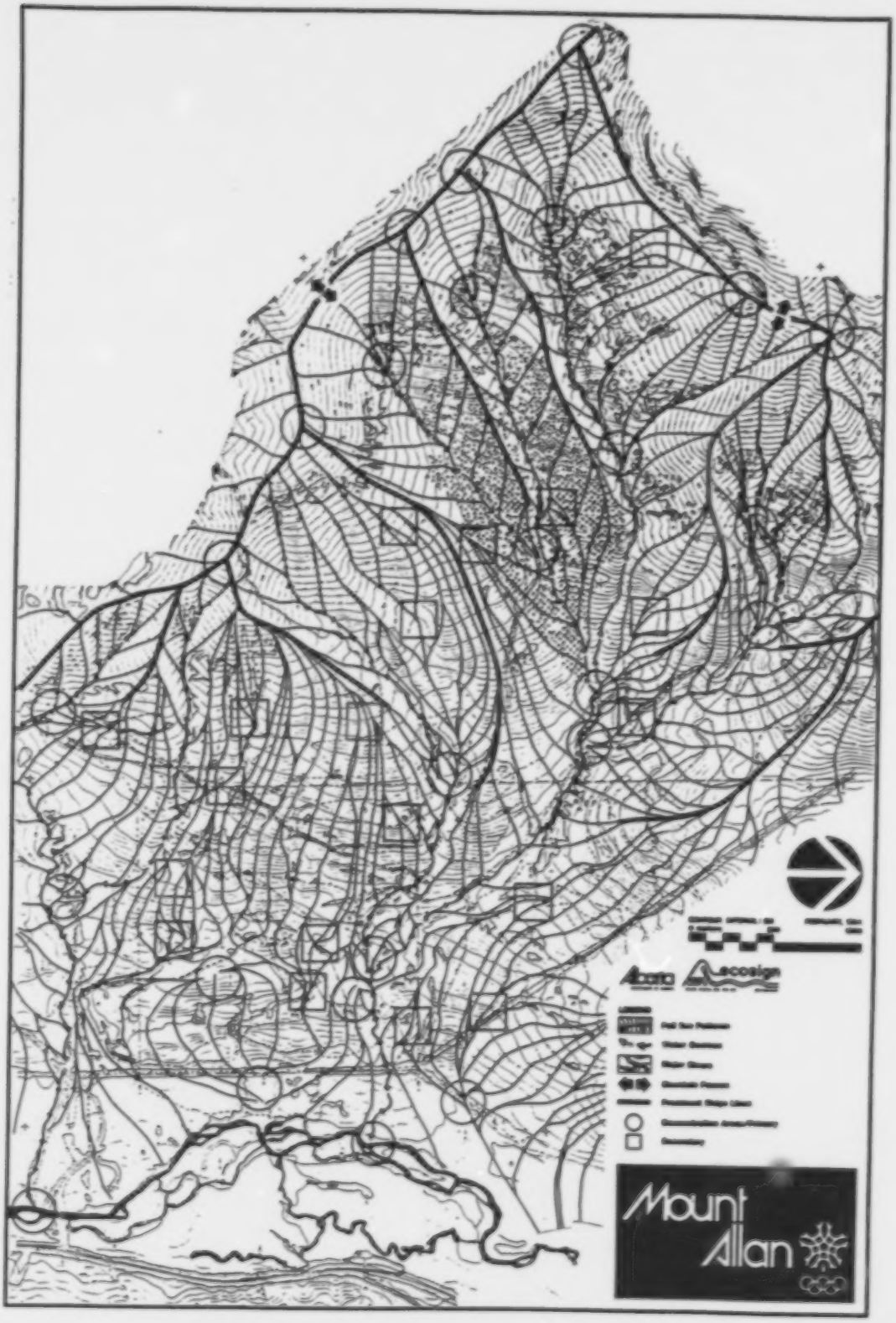


FIGURE 5
Fall Line Analysis Example

The Fall-Line and Slope Analysis maps are utilized in the evaluation of the terrain and form part of the criteria for trail and lift placement.

The overall skiing potential of the site is developed through a process of combining information generated from the various inventories and analyses undertaken in conjunction with the following criteria:

- continuous fall-line skiing from top to bottom
- suitable upper and lower lift terminal locations (e.g., 0.2 hectares (0.5 acres) less than 25% slope)
- good slope continuity to allow interesting skiing from top to bottom for one or more skier ability levels
- natural slope gradients primarily greater than 8% and less than 70%
- avoidance of areas with mariginal snow and/or wind scour
- avoidance of spatial conflicts with critical wildlife habitats

A Terrain Capacity Analysis Map (see Figure 6) can be prepared which outlines the most suitable areas for lift and trail development, based upon the previous considerations. Potential is shown in the form of terrain pods and each pod is described as to specific development possibility and the lift capacity necessary to serve the terrain within each pod. The terrain capacity analysis also provides an indication of the general balance of the developable terrain. The Mount Allan Terrain Pod Balance chart shown in Figure 7 indicates that the natural ski terrain is nearly perfectly balanced to the Alberta skier market.

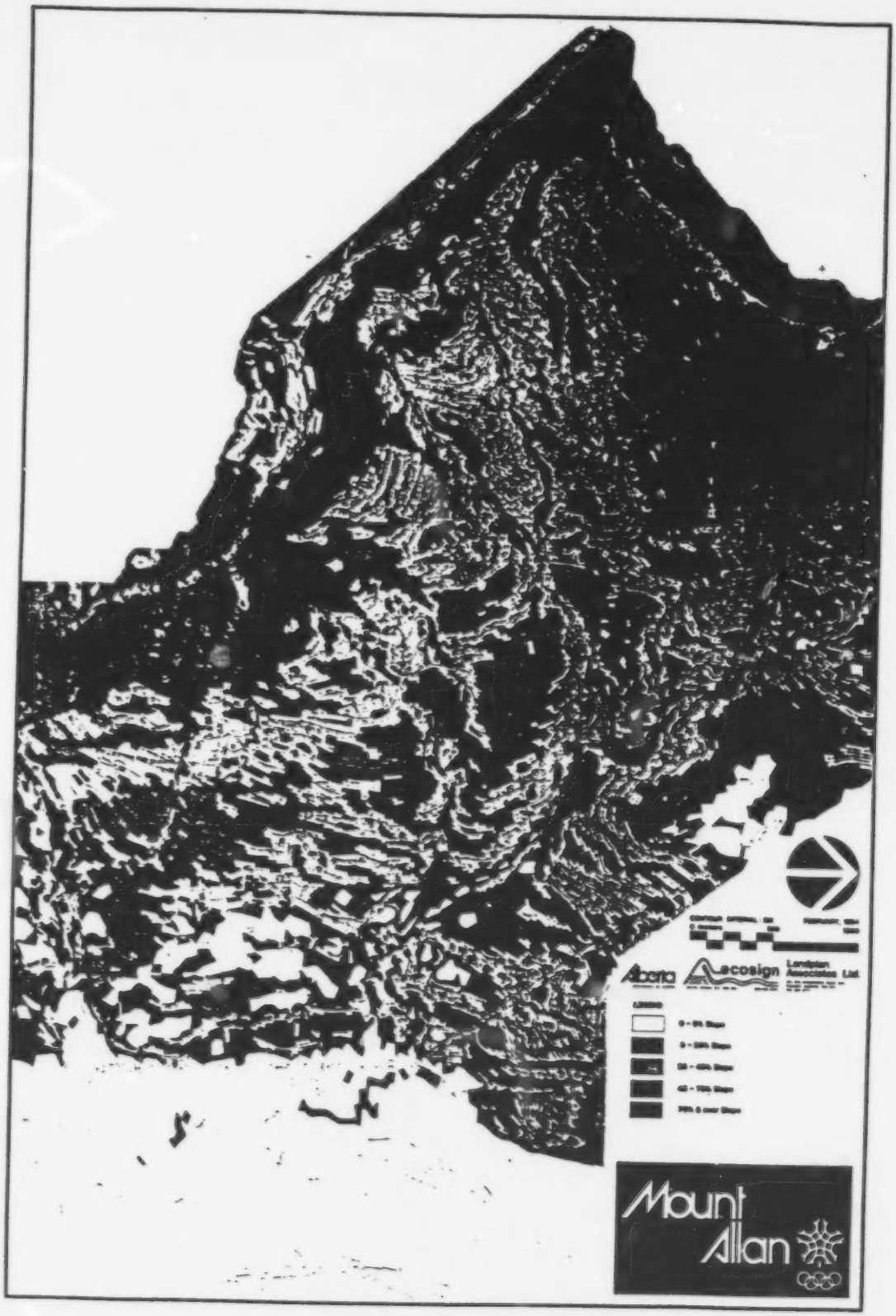
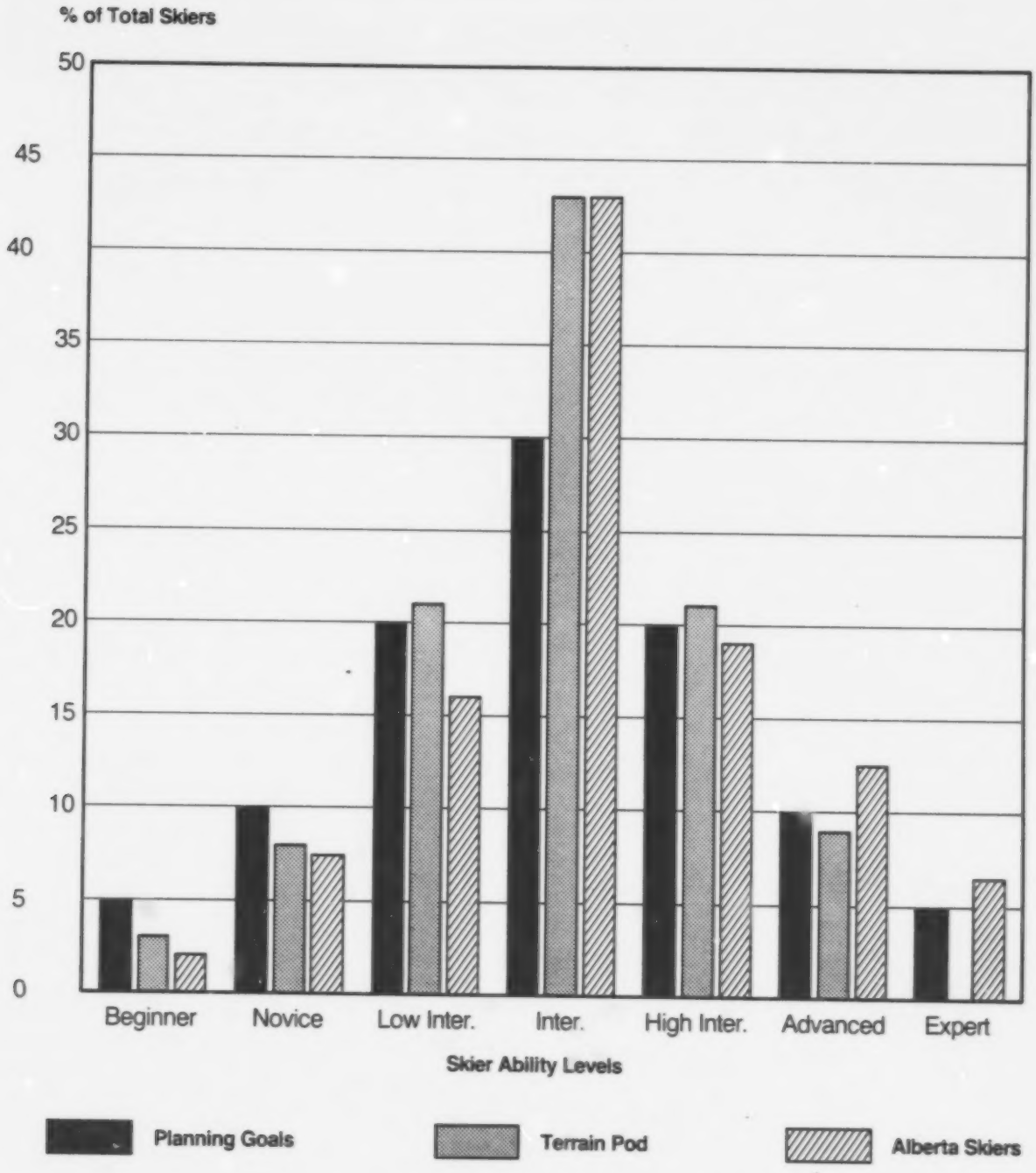


FIGURE 6
Terrain Capacity Analysis Map Example

FIGURE 7

Mount Allan Terrain Pod Balance Example (1984 Master Plan)



Since very few sites in Alberta possess natural snowpacks suitable for downhill skiing in the early winter, snow making systems provide an early ski season opening.

The combination of a machine snow base to cover natural hazards normally present at ski areas without snow making (i.e., rocks, stumps, bare patches), with a natural snow skiing layer on top provides excellent ski conditions, particularly in the early season. Snow making systems are now considered an essential ingredient to an economically viable ski area to provide guaranteed early season skiing with quality conditions throughout the season. Machine snow will support greater wear and tear on ski trails than natural snow, and offers a ski area the opportunity to generate higher levels of ski trail utilization, particularly in years where natural snowfall is lacking.

2.07 Fixed Equipment and Facilities

Lifts and Tows:

In any ski development, the uphill transportation and maintenance equipment, are a substantial investment. Several factors should be considered in planning and constructing lifts and tows. These include:

- Location
- Selection
- Safety Guards and Statutory Requirements

Location:

The location of lifts or tows determines the distribution pattern of skiers throughout the area.

Congested areas on a ski hill due to inappropriate placement of lifts and tows can make it less desirable to the skiers and cause traffic and safety problems. Location of the lifts and tows should be determined by:

- distribution of the various ski slopes and trails
- natural physical aspects of the terrain and vegetation
- visual impact of cutting a line through timber
- environmental impact of the lift line
- location of the base area and distribution of skiers from it
- ease of servicing and maintaining the lift

The amount of clearing required for the location of a lift or tow line will be determined by the particular type used.

Selection:

A suitable lift or tow system should move skiers up the hill in the most efficient and economical manner possible. Several methods of moving skiers up a hill are:

- rope tow
- T-bar
- platter or poma lift
- chair lift
- aerial tramway

See also Section 3.03.

The type most suited to a particular development would be selected on the basis of:

- slope and area capacity
- terrain
- power and energy sources available
- length of lift required
- veritical rise of the lift line
- cost

Each type has certain requirements and limitations (see Table 10). Of course, the more sophisticated equipment such as a chairlift or aerial tram requires more capital expenditure and possibly higher maintenance and operation expenditures.

TABLE 10

Types of Lifts and Tows - Requirements and Limitations

TYPE OF LIFT	DESCRIPTION	REQUIREMENTS	LIMITATIONS
Rope Tow	- consists of heavy gauge rope driven uphill between two pulleys, one being a drive pulley or wheel.	- drive motor, usually internal combustion and gas run, linked to drive wheel.	- maximum length of 366 m (1,200 ft). - not suitable for long periods of time and steep terrain.
T-Bar	- consists of "T" shaped bars attached to a steel cable moving uphill. - carries two per-persons on each T-bar.	- drive motors require power for overhead cable. - groomed snow track. - loading attendant.	- length up to 1,463 m (4,800 ft).
Poma Lift Platter Lift	- consists of a bar with platter or disk on the end connected to an overhead steel cable moving uphill.	- groomed snow track. - loading attendant. - lift tower. - overhead tower.	- can carry only one person per unit.
Chairlift	- consists of suspended chair from overhead cable carrying person uphill.	- high towers. - loading and unloading platforms. - loading and unloading attendant. - heavy capacity motor.	- extensive length. - passengers subjected to weather extremes. - problems in high winds sometimes requiring shutdown.
Aerial Tram	- consists of suspended enclosed units connected to an uphill cable. - requires stoppages to load and unload units.	- the most powerful drive units. - loading and unloading attendants. - heavy duty lift towers. - wide lift lines.	- requires cable stoppages. - only feasible for long lift requirements. - problems in high winds sometimes requiring shutdown.

SOURCE: 1976 Edition "Ski Area Planning" (modified).

Safety Guards and Statutory Requirements:

All tow equipment, sheaves and supports, accessible to skiers should be fenced or guarded. Any electrical wires or terminals should be boxed in or enclosed. See also sections 4.05 and 4.06.

Actual Versus Theoretical Capacity:

Theoretical capacity is based on the lift running continuously and all bars or seats being fully loaded (see Table 11). It is often necessary to stop surface lifts because skiers fall while loading or on the lift line. The number of stops varies with the general ability of skiers at the area, the condition of the lift line, etc.; but it would not be unusual to lose 10% of capacity for these reasons. On aerial lifts there is less tendency for skiers to fall while loading and of course they are not affected by surface conditions of the lift line. It should very seldom be necessary to stop an aerial lift except in high winds.

Use of Terrain:

As skiing on or across surface lift lines is not permitted, this land is removed from the skiable area, and approximately .8 ha (2 acres) would be lost on a 610 m (2,000 ft) hill.

TABLE 11
Theoretical Maximum Lift Capacities

(Skiers Per Hour)

TYPE	SINGLE	DOUBLE	TRIPLE	QUAD
Platter	800			
T-Bar		1,500		
Chair		1,200-1,500	1,800-2,200	2,900 ±

SOURCE: Doppelmayr Lifts Ltd.

Capacities are based on loading every bar or chair and lifts running continuously (no stops).

Also, a surface lift splits the hill and limits the variety of runs. The area under an aerial lift can normally be used as ski run.

Surface lifts require a continuous incline, which limits the locations in which they can be installed. Also they cannot cross existing ski runs. Aerial lifts are not affected by either of these factors.

An analysis of the base area should be undertaken to identify opportunities and constraints for facility development. Existing topograhy should be analyzed and slope gradients coded according to the following categories:*

Slope	Development Suitability
0% - 8%	parking, day lodge
8% - 15%	terraced parking, day lodge
15% - 30%	unsuitable for some development
30% - 40%	unsuitable for most development
40% +	unsuitable for development

Provision may need to be made on-hill for lift/tow operators' huts and shelters.

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* From "Mount Allan Master Plan - Summary".

2.08 Utilities and Services

"The same basic services are needed at ski resorts as those required for any township, however, because ski resorts are established in mountain terrain the services have to function in extremely cold weather conditions, and special consideration has to be given to this aspect in the design, construction and operation of each facility. Water services have to operate without freezing up, sewage plants have to produce a satisfactory effluent in freezing conditions, roads and car parks have to be capable of being cleared of snow, to list just a few of the special problems.

In addition, the ski field has to accommodate the lifts and the trails for the skiers and also perhaps snow making equipment and night lighting. Public service and maintenance buildings, accommodation, ski trails, parking lots, lifts and terminal structures should also be located so that the potential of the area can best be realized, circulation conflicts minimized and basic grading and drainage needs determined.

Planning should fit with the ultimate development concept. Power, water, and sewage systems should be located in a manner that they will not need to be changed as development progresses."*

Ski areas, because of their often rural or remote location often lack access to municipal services. Information on location, costs and requirements of these services should be obtained prior to any design of the base area. The data required includes:

Water Supply:

- Availability of water in terms of source, quality and volume
- Costs for servicing facilities if available from local municipality

Sewage Disposal:

- Contact Alberta Environment concerning legal sewage disposal restrictions and requirements for the site area
- Determine what type of system is best suited for the site - septic tank and field, municipal or pump out

Electrical Power Supply:

- Determine the availability of electrical power
- Compare costs of connecting to an existing power source with cost of a generating system on the site

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* From "Ski Resort Planning and Development".

Heating:

- Determine what form of heating is best suited for the site
- Determine the costs for fuel alternatives

Communications:

- Communication from the site to the nearest community and businesses is needed
- If telephone communications through established lines are impossible, a radio phone may be required
- Communication with medical and hospital services is essential

All service systems must conform to the National and Provincial Building Codes, as well as any local codes.

Snow making is now considered to be a significant and necessary service for any ski area. The following information has been derived from the "Ski Resort Manual" (Ontario):

Snow Making:

Consideration must be given to environmental, technical, and perhaps the most important, financial factors in any review of snow making systems.

Difficulty lies in recognizing the accuracy of available data. Only those who are familiar with this data, having experience of different designs, types, construction and operation of snow making systems, can make an effective decision on which system to use.

Snow making can often reduce profit margins, even if it lengthens the season and increases the income. Because snow making is a heavy energy user, future costs of operation of any and all snow making will be a major consideration. Extending the season, income and costs without a comparable increase in profit is illogical, as well as risky and the result of a poor management decision.

Analysis for snow making is divided into four basic considerations:

- Meteorological
- Logistical - (area characteristics and environmental considerations)
- Financial Feasibility
- Technical:
  - Design
  - Installation
  - Operation

The order of this assessment is important. Each successive section is more involved and more expensive to carry out. As well, each successive section depends on a positive result from analysis of the previous one.

Meteorological Considerations:

- Temperatures, averages, means, highs, lows, degree days of frost and thaws
- Snow depths, snowfall measured, snow on the ground measured each month, day, etc., and other precipitation
- Wind conditions, direction, force, fog, and even humidity
- Data should be analysed over a period of time.

From the data, the following information is gathered:

- Measured snowfall.
- Measured snow on the ground.
- Calculated make-up snow (artifically made) needed to operate the required number of days per season. This make-up snow must be made to allow for skier wear, thaws, rainstorms, etc. This will determine required system capacity.
- Design operating temperature - a system, although it operates over a range of temperature, has one point to which its capacity is designed. This temperature represents the most common temperature that the area will experience over the most number of hours. Capacity of the system (i.e., its ability to produce snow) is selected at this point. For compressed air-water systems, this should be the point where all air and water is used. Below this temperature the system capacity should be constant with progressively less energy consumption. Above this design temperature, water conversion falls off accordingly. Air consumption remains maximum. This temperature is the point that the area operator can depend on for a given production.
- Available operating funds to make snow. The system must be adequate in size to make the desired quantity of snow annually, in 50% or less of the available snow making hours. The two other criteria, that effect the system size are - water temperature and, to a much less extent - elevation. These influences are considered under "Logistics".

Logistical Assessment and Area Characteristics:

From this section, determination of required logistics - i.e., power, water, and various area characteristics will indicate the type of system, or combination that will be most effective and efficient.

Adequate water with reasonable access and temperature is a prerequisite under all conditions. Assessment of voltage, quantities, and cost of power is essential.

A detailed evaluation of slope lengths, widths, and percent grades will be one of the most important aspects of assessing which type of equipment will be selected. Continuous steep slopes from top to bottom could eliminate all airless equipment from further consideration. Long slope lengths could eliminate electrical distribution systems. Environmental considerations must be taken into account, including local and government regulations (provincial, federal, etc.) Noise pollution near hotels and other serious environmental limitations can affect the cost of installation and operation.

In addition soil and underground conditions must be evaluated.

This area of consideration is the section that will most affect detailed designs and subsequent costs.

Provided that water, power, slope parameters, soil conditions, planning and environmental limitations do not rule out snow making entirely, then a financial feasibility study can be commenced.

Financial Feasibility:

To begin with, full preparation of past and present, if available, and future performance of the area, without snow making, must be established. This should include a complete financial study.

Systems must be compared from a capital, operating, and maintenance cost point of view, local cost parameters must be used with respect to labour, energy, transportation, etc.

When all financial considerations are completed, including cash flow, capital costs, operating costs, payout time, and return on investment - a decision can be made whether or not to proceed.

Reconsideration of design, including use of combinations of systems, types, or reduction of size may make significant change on the ultimate financial consideration.

It may be that the area is successful enough without snow making, that a snow making expenditure would reduce the existing margin of profit and thus the return would be negative. Increase in revenue without comparable increase or improvement in profit only increases the risk, in an already risky business.

Technical - Design - Construction - Operation:

If there are no objections to the snow making plan, meteorologically, logistically, environmentally and financially, a clear plan can be presented to capital sources.

Technically and financially an operator may select a specific system type. Additionally there is the option of having a consultant design or a manufacturer design and build the system. Combination systems are best designed by professionals who have experience.

See section 3.05 and 4.07 for further information.

Table 12 lists a series of observations which illustrate the critical variables that have a bearing on a snow making investment decision.

These observations are the result of the development of a detailed technical and financial snow making systems analysis prepared by Jeff White, P.E., and Ted Farwell, MBA.

TABLE 12
Snow Making Variables

PHYSICAL	ECONOMIC
1) Temperature (Air)	1) Acceptable density/acre
2) Temperature (Water)	2) Capital investment
3) Water source and flow	3) Labor rates
4) Water rights	4) Energy rates
5) Type (Compressed air, LP air)	5) Cost of capital
6) Acres of coverage	6) Property tax rates
7) Terrain characteristics	7) Normal opening date
8) Power source	Ski area economic characteristics
9) Soil Conditions	
10) Electrical codes	
11) Natural snowfall	

SOURCE: White, P.E. and Farwell, Ted.

Access Roads:

Access roads can be a very expensive proposition and should be assessed with great care. Alberta Transportation should be consulted. Existing tree cover along the access road and adjacent to parking areas should be preserved wherever possible.

2.09 The Master Plan

The specific inventories, studies, etc., described in previous sections all interact to determine the capabilities and suitability for the design and development of a recreational ski area. Essentially this means identifying the best possible opportunities on the site to accommodate the various requirements identified. It also offers a means of identifying constraints to development and potential issues which must be resolved in order to successfully complete the project.

Inventories should also be undertaken on contextual elements such as controlling legislation and policies. Land ownership and tenure, municipal government services and other controlling legislation should be examined in order to determine what opportunities and limiting factors there might be with respect to the proposed development program and its subsequent operation and management.

To assist in planning for the base area, zones with respect to usage could be defined, these may overlap as some facilities serve several purposes. A listing of the facilities in most zones with the required area is given in Appendix F.

- Zone 1 - Public Day Use
  This zone includes all facilities and areas which provide the basic support for recreation activity. Included are public areas such as food services, lounge, warm-up areas, change rooms and lockers.

- Zone 2 - Public Overnight
  Public overnight accommodations include lodging and support facilities available to the public on a day-by-day rental basis.

- Zone 3 - Exclusive Overnight
  This category includes privately owned cabins, cottages and condominiums.

- Zone 4 - Maintenance, Utility and Storage
  Spaces occupied by maintenance buildings, vehicle storage, utilities, and service equipment storage.

- Zone 5 - Open Space
  The area should include some open space that will be retained undeveloped, for aesthetic purposes.

The Master Plan report and accompanying drawings can vary substantially depending on such factors as:

- location of site (e.g., Crown, private or municipal land)
- nature of ski area developers/operators (e.g., public, private or non-profit)
- extent of development

No matter which is applicable, your investment in planning now can result in savings in the future.

Two examples of master plans which are available publicly are:

- Mount Allan
- Cypress Hills Ski Facility

A review of these documents will illustrate the variation in presentation and provides an insight into the entire process.

2.10 Construction and Operation Budgets

Now comes the time for firming up budgets. Ski area planning consultants should be able to provide fairly accurate (± 5% or better) cost estimates for implementation of their master plans. They have previous cost data in their records. For those who have attempted preparation of their own master plans, consultation with a ski area planner would be advised in conjunction with cost estimates from various sub-consultants and/or industry suppliers.

Lift and tow costs vary substantially being a function of items such as:

- gradient of slope
- length of slope
- variation of slope
- location
- type of lift/tow and factor such as speed

Industry suppliers usually can provide estimates very quickly.

There is no one cost for snow making. Snow making capital costs (for equipment and installation) vary depending on climatic factors, type of system, capacity and coverage required.

Operating and maintenance costs vary considerably based on the type and capacity of the system, power demand and energy rates, labor and vehicles required.

To be economically feasible, snow making must accomplish two things.

- It must increase the length of the ski season by allowing for an earlier opening when skiers are more highly motivated.
- It must be acceptable to the market to trade more crowded conditions for the more dependable and better snow coverage.

Snow making can also be considered as an insurance measure, (see Section 4.05). For more detailed information on constructing and operating your ski area you may wish to consult:

- CWSAA
- another similar non-competing ski area
- "Ski Resort Manual" (Ontario)
- planning and other ski area consultants
- individual equipment suppliers and installers

CHAPTER III

DESIGN AND CONSTRUCTION

3.01 Barrier Free Design

Barrier free design is the process of eliminating unnecessary obstacles and the design of special features to make the environment accessible to everyone. It is designed for permanently and temporarily disabled people, the elderly, younger children and able-bodied people carrying packages, ski equipment, etc. In other words, we can all benefit from improved safety and ease of use of environments designed to accommodate our human needs.

Skiing and associated winter sport activities by disabled persons is increasing. The Canadian Association for Disabled Skiing with its Alberta affliate was formed specifically for such persons.

No special slope design considerations need be made for disabled skiers. For obvious reasons, uphill areas requiring walking with skis should be avoided.

Some special design considerations for disabled skiers are:

- minimize the number of steps and steep grades around the base area
- provide special parking areas close to the lodge and lifts
- provide ample seating in the lodge close to the concession area
- provide rough rather than smooth floor surfaces

For further information on planning and designing for the handicapped skiers, see "Tapping the Handicapped Skier Market" and see also "Recreation and Accessibility Guidelines for Making Kananaskis Country Accessible to Physically Disabled People".

3.02 Ski Area Design Criteria

Special consideration to ski area standards must be given. There are some industry norms that are used for preliminary and master planning and some guidelines exist for final site specific design. This section reviews most of the standards and norms currently in use. It is based extensively on the report "Ski Resort Planning and Development", by Ron Sibley and includes extracts from work by Ted Farwell.

> Lift and trail systems should be designed to minimize crowding, conflict and worn-out snow conditions. Use of various lift loading and unloading patterns can direct skiers onto preferred trail systems to improve trail use and avoid major congestion areas. One of the most important considerations in the construction and operation of a successful downhill ski resort is by providing a balanced lift and trail complex that approximates the experience levels of the supporting market area.*

The results of Chapter 2 are integrated into the detailed ski area design process. Figure 8 shows an example of a mountain design analysis for Mount Allan.

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* From "Mount Allan Master Plan - Summary".

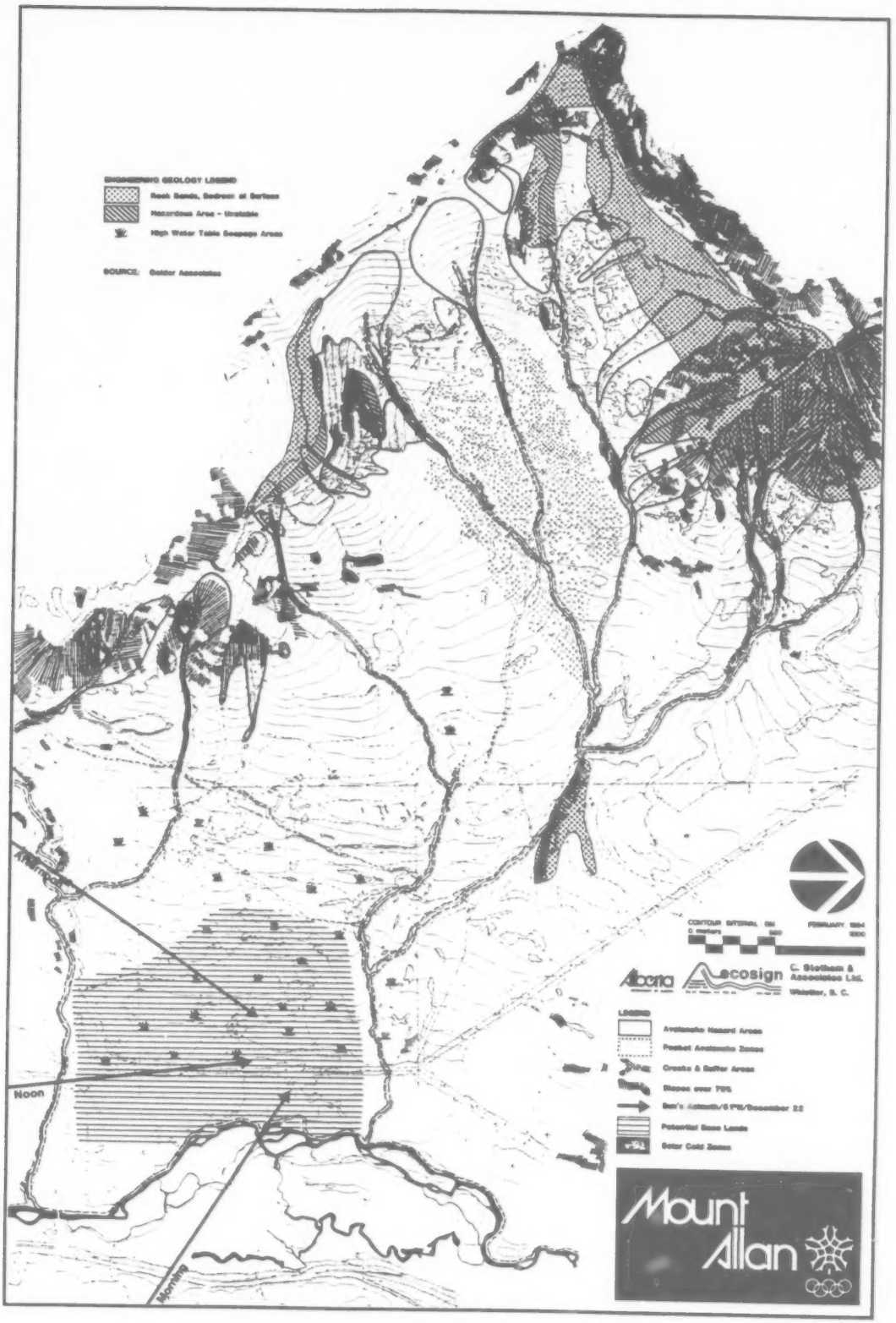

FIGURE 8
Mountain Design Analysis Example

Ski Field Design Criteria*

(i) Lifts

The number and location of ski lifts is generally controlled by the location, developed areas and design capacity of the ski slopes. Possible lift terminal points must satisfy several criteria. The first and most important is that the area be relatively flat - between 0 and 20° slope. This area must be a minimum of 0.4 hectares in size, with a larger area preferable. A wind protected area with the possibility for good views adds to the desirability of a site as a lift terminal point. A site may satisfy all of the above criteria yet not be a suitable lift terminal point because the lift alignments possible from that point do not serve skiable terrain.

(ii) Pods

A pod is the group of runs served by one lift. As ski runs work best when they are parallel to the fall line, an area where fall lines meet at a high elevation, then separate and then meet again at a low elevation, provides an ideal ski pod, assuming that any unskiable terrain within the pod can be avoided. In order to establish a ski pod, such a fall line pattern must exist with potential ski terminal locations at the upper and lower ends of the pod. Orientation to the sun must also be considered. Although a pod may be pleasant because it has a good orientation to the sun, it may tend to loose snow rapdily in the spring. It can be prone to avalanches because of the freeze-thaw caused by extreme variations. The alignment of the lift should be wind protected whenever possible.

(iii) Runs

Once a lift alignment and pod outline have been selected, specific runs within the pod can be chosen. Several criteria have been set down to arrive at run locations, and run widths.

(a) General Guidelines -

i) Ski runs should be constructed at right angles to the contour of the slope (parallel to the fall line) (see Figure 9). These runs are easier to ski, have greater capacity, require less maintenance than "side hill" slopes and are easily groomed.

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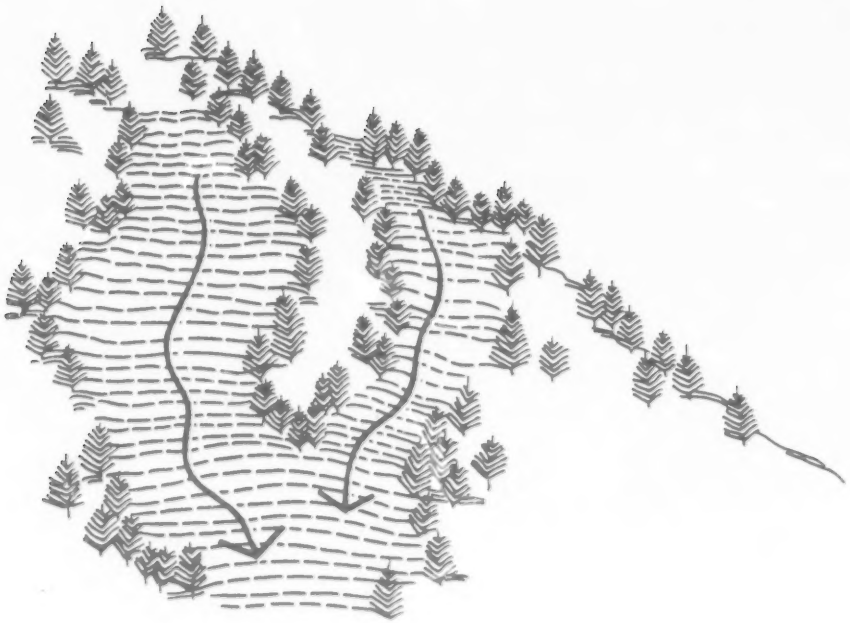
* From "Ski Resort Planning and Development".

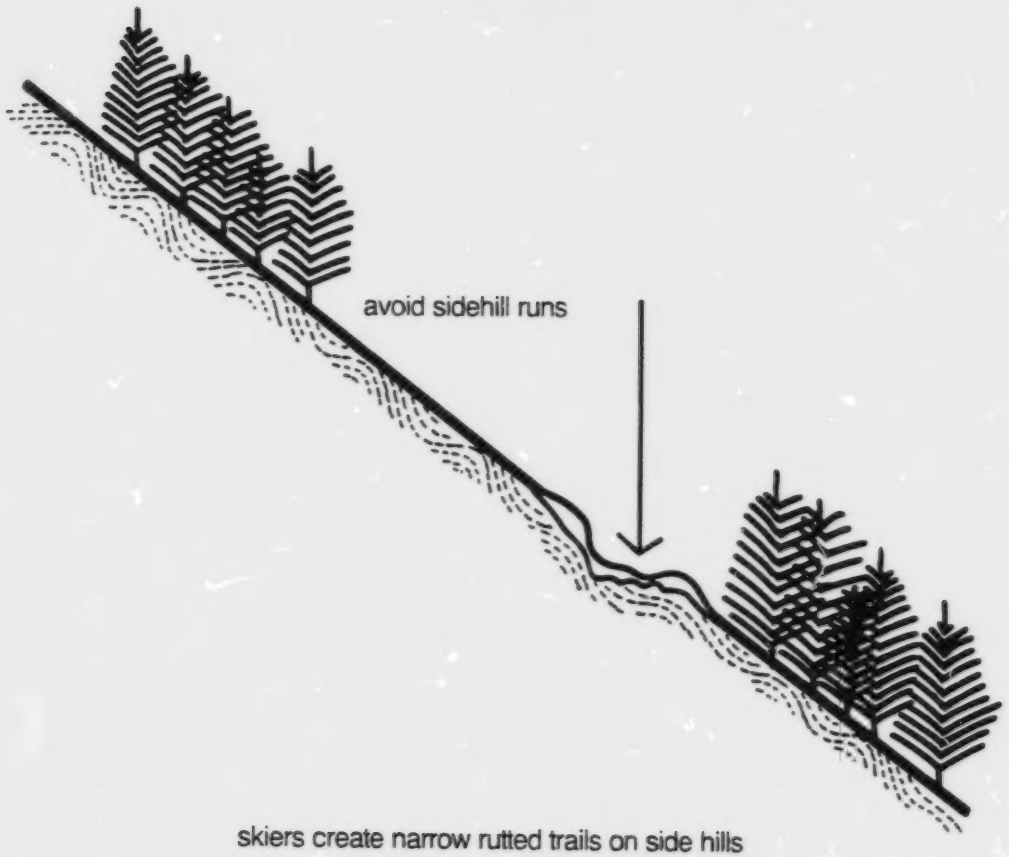
FIGURE 9
Ski Run Location



locate parallel to the fall line at right angles to the slope

ii) Traverses (catwalks) that run perpendicular to the fall lines are sometimes necessary to provide access to and from ski runs, however, they should be kept to a minimum. Too often an old road is used for this purpose. Ideally, a catwalk should be concave to start with, with disturbed soils reseeded and drainage taken care of. Generally, a 10% traverse will form snow surface waves, a steeper traverse will become dish shaped (concave) (see Figure 10).

FIGURE 10
Traverse Avoidance



iii) Prevailing winds should be studied by instrumentation if possible, or by observing the drifting snow in timber, or on ridges. Run widths and trail location must consider wind exposure. The bends in a run can reduce the overall wind scour by slowing the wind movement.

Protection from winds will maximize snow cover in a limited snowfall area. Ideally for prevention from drifting and wind blown areas, ski runs should be at right angles to the prevailing winds (see Figure 11).

FIGURE 11

Wind Protection for Ski Runs

leave groups of trees to avoid windthrow and to protect skiers from prevailing winds that are extremely cold.

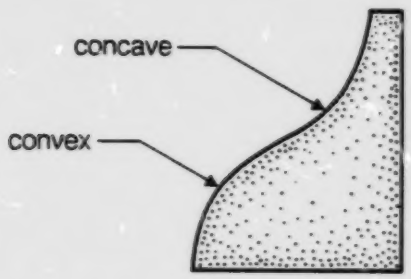
iv) On sun exposed slopes, the steepest ones will catch the most sun and therefore crust sooner and more severely than those with flatter grades (see previous Figure 4).

v) On steeper slopes (above 50%) timber is especially valuable to retard erosion and help prevent avalanches.

vi) A convex run (ridge type) will develop moguls faster than a concave slope (shallow gully) of the same grade and width; thereby decreasing its capacity (see Figure 12).

FIGURE 12

Concave and Convex Ski Slopes



vii) With heavy ski use on a 20% to 30% slope, the snow surface will change from a flat slope to an artificial gully. Wide slopes help prevent this situation.

viii) On flat or convex slopes of over 25%, wider runs and lighter use will reduce moguls, but they cannot be eliminated without maintenance.

ix) Whenever a slope increases, the run should be widened.

x) The skiable portions of runs should be kept to a minimum width until the run receives more and more use and then be widened to the maximum. The following guidelines should be applied where ever clearing is necessary:

	Minimum	Maximum
Beginner/ Novice	50 m (164 ft)	100 m (328 ft)
Lower and Advanced Intermediate	30 m (98 ft)	75 m (246 ft)
Expert	30 m (98 ft)	60 m (196 ft)

xi) For wind and snow control, one-third to one-half of the area should remain timbered, if possible. Glade skiing, where the small timber has been removed leaving areas can be very appealing especially in areas of heavy powder snow fall, or foggy or poor light weather.

In some instances separate areas for practice and teaching slopes could be made. Groups lessons tend to create congested areas. Slopes would likely be in 10% to 20% range.

(b) Specific Guidelines -

i) Novice Slopes:
There should be a gradual shift of less than 20% slope to a flat area. Level unloading or slight downhill to level gathering area is preferred. Novice slopes should be close to the base lodge and parking and separated from other steeper slopes.

ii) Intermediate Slopes:
Low intermediate slopes should be between 20 and 30% slope with advanced intermediate between 20%-45% slope. Isolated intermediate slopes can be used for group skiing instruction.

iii) Advanced Slopes:
Advanced and expert slopes should be between 45% and 80% slope. Any slope greater is considered unskiable.

iv) Ski Area:
A ski area should have a mix of ski runs of approximately 15% of the skiable terrain as novice, 55% as intermediate and 30% as expert.

The following is a list of "rules of thumb" that have been used as a guide to determine the capacity of facilities of the Kimberley Ski Resort (British Columbia) and to project rates of growth.

i) A ski area is considered at capacity when it reaches between 40% and 45% of total possible skier days for the whole season.

ii) The capacity of a lift is determined by multiplying its capacity per hour by its vertical rise and then dividing by the number of vertical feet (metres) per hour. A skier of the particular ski runs ability (served by the lift) can ski ...

iii) Skier's Ability	Vertical Metres (VTM) Skied per Hour	Vertical Feet (VTM) Skied per Hour
Novice	183	600
Lower Intermediate	610	2,000
Advanced Intermediate	823	2,700
Expert	976	3,200

iv) To calculate down-hill capacity:

	Acceptable Skier Densities Skiers/Hectare/Day	Acceptable Skier Densities Skiers/Acre/Day
Novice	62	25
Intermediate	37	15
Expert	12	5

v) The mix of ski runs of a ski area are in the following proportions:

Novice	15%
Intermediate	15%
Advanced Intermediate	40%
Expert	30%

vi) A new lift and/or other facility (such as ski lodge) will cause increased skier visits, but when a ski area nears capacity, (between 40% and 45% of total skier days) and lines begin to form, before new facilities are built, growth rates will decline.

The following Tables (13, 14 and 15) produced by Ted Farwell, outline various ski area planning parameters.

TABLE 13
Terrain Capacity

SKILL CLASSIFICATION	TERRAIN GRADIENTS	MARKET PROPORTION	RANGE SKIER DENSITY/HECTARE (ACRE) ON SLOPES		TOTAL SKI AREA	
Beginner	10%-15%	5%	54-109/ha	22-44/ac	124-247/ha	50-100/ac
Novice	15%-25%	10%	44- 64/ha	18-26/ac	99-148/ha	40- 60/ac
Low Intermediate	25%-35%	20%	32- 54/ha	13-22/ac	74-124/ha	30- 50/ac
Intermediate	30%-40%	30%	22- 37/ha	9-15/ac	49- 86/ha	20- 35/ac
Advanced Intermediate	35%-45%	20%	17- 22/ha	7- 9/ac	37- 49/ha	15- 20/ac
Advanced	45%-60%	10%	10- 17/ha	4- 7/ac	25- 37/ha	10- 15/ac
Expert	60% +	5%	10- 17/ha	4- 7/ac	25- 37/ha	10- 15/ac
AVERAGE			20- 32/ha	8-13/ac	47- 86/ha	19- 35/ac

Conversion Factors: one meter = 3.28 feet and one hectare = 2.47 acres.

Source: Ted Farwell

TABLE 14
Analysis of Skier Distribution

	FARWELL		MAMMOTH	
Areas of Slopes	21.3 ha (52.6 acres)		21.3 ha (52.6 acres)	
Skiers on Slopes	440	44%	235	23%
Skiers on Lifts	230	23%	200	20%
Skiers in Line	230	23%	290	29%
Skiers in Lodge	100	10%	275	28%
TOTAL Design Capacity	1,000	100%	1,000	100%
Design Density	47 ha	(19 acres)	47 ha	(19 acres)

SOURCE: Ted Farwell.

TABLE 15
Uphill Capacity

SKILL CLASS	WEIGHTED AVERAGE DEMAND				VERTICAL DEMAND PER DAY*			VTF/HR DEMAND RANGE		
	HIGH	AVERAGE	LOW	SKILL MIX	HIGH	AVERAGE	LOW	HIGH	AVERAGE	LOW
Beginner	23.2	20	14.9	5%	2,320	2,000	1,485	464	400	297
Novice	104.5	90	66.8	10%	5,225	4,500	3,340	1,045	900	668
Low Intermediate	278.8	240	178.0	20%	6,970	6,000	4,450	1,394	1,200	890
Intermediate	557.4	480	356.1	30%	9,290	8,000	5,935	1,858	1,600	1,187
Advanced Intermediate	418.0	360	267.0	20%	12,540	10,800	8,010	2,090	1,800	1,335
Advanced	243.8	210	155.8	10%	14,628	12,600	9,348	2,438	2,100	1,558
Expert	174.2	150	111.3	5%	20,904	18,000	13,356	3,484	3,000	2,226
TOTAL	1,800	1,550	1,150	100%						
AVERAGE					9,836	8,470	6,283	1,800	1,550	1,150

* Based on 5 hours of skiing for beginners through intermediate and 6 hours of skiing for advanced intermediate through expert.

Lift capacities are fairly standard at 1,200 people, 1,800 people or 2,400 people per hour.

Another formula used for calculating lift pod capacity is:

$$CP = (CL/60)\ (L.E.)\ (TW + TL = TS)$$

where -
CP = effective lift pod design capacity.
CL = hourly lift capacity (skiers/hour).
LE = experience lift efficiency factor on a capacity day.
= 0.925 or 1.5 chairs missed out of 20.
TW = wait time for lift boarding.
TL = lift ride time (minutes).
TS = ski down time - ski down time has a converse relationship with the steepness of the slope (the steeper the slope, generally, the better the skier and therefore, the lesser the ski down time). Consequently, the following rations are used:
Expert terrain = 1.2 x TL
Advanced intermediate terrain = 1.47 x TL
Low intermediate terrain = 1.74 x TL
Beginner terrain = 2.0 x TL

SOURCE: Ted Farwell

Ski runs are plotted on the contour plans after careful consideration of enviromental plans and study of slope considerations, but their final placement and detail is surveyed in the field.

In forested areas the ski runs form clear cut lines. A computer system using digitizer, plotting peripherals and topographic maps has been devised so that perspective plots can be made illustrating how the runs will look from specific off-site viewing points. Screening ski runs from view or shaping them to characterize natural openings are current methods used to meet desired visual objectives.

Points to be considered when laying out the ski runs:

i) Continuity of gradient for full length of slope where classified for novice and intermediate skiers.
ii) Eliminate possible conflicts between skier traffic and congestion areas around terminals.
iii) Anticipate traffic patterns and capacity requirements including provision for smooth transition of skier flow at all trail junctions ...

... The removal of rock and timber from ski runs increases the amount of useful ski terrain under minimum snow conditions and increases skier safety. Once this work is accomplished, it is usually not necessary to repeat the process and improvements are assets of the ski areas.

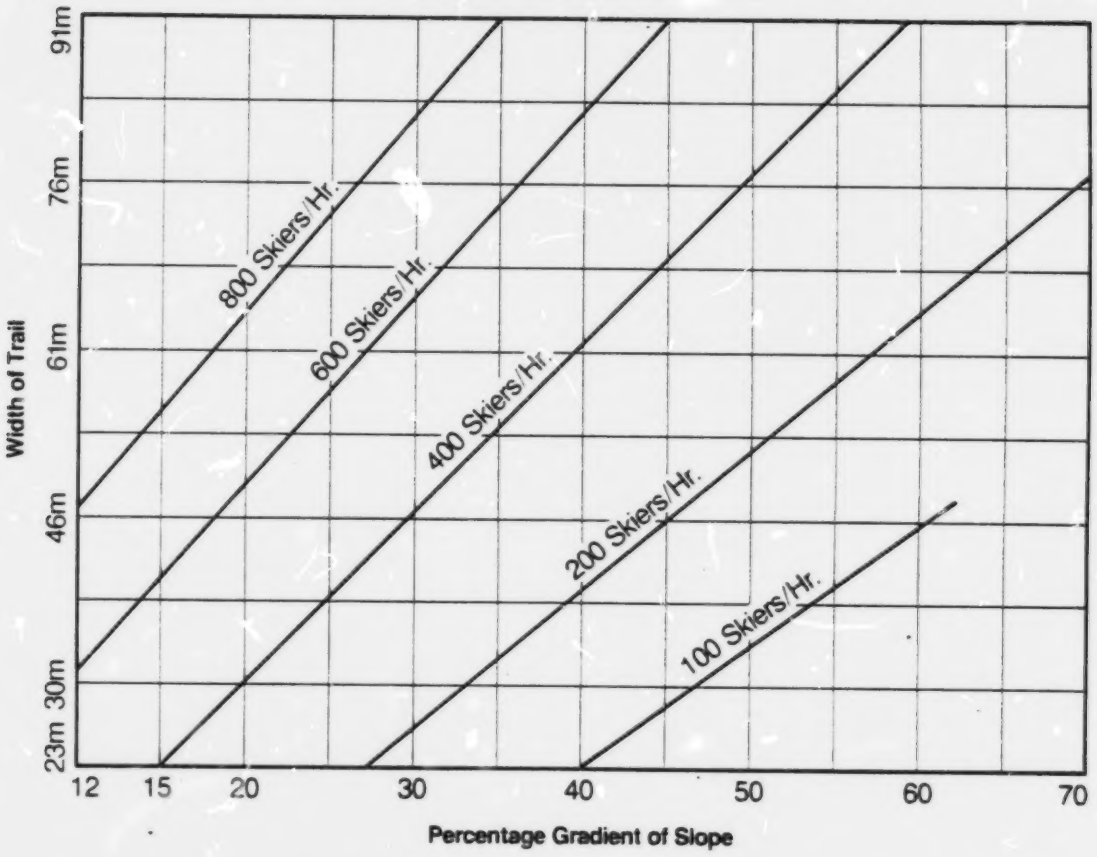
Figure 13 shows how the capacity of a particular run can be determined approximately based on percent gradient and width of trail. The chart can be used to determine proper gradient, trail width or capacity, given at least one of the variables.

For example, what is the capacity of a 30 m wide run at 20% gradient. The answer is 400 skiers per hour.

The capacity varies with snow conditions and type of snow. Machine made snow can increase capacities substantially.

FIGURE 13

Ski Slope Capacity Chart



Variety on the slopes can be provided by:

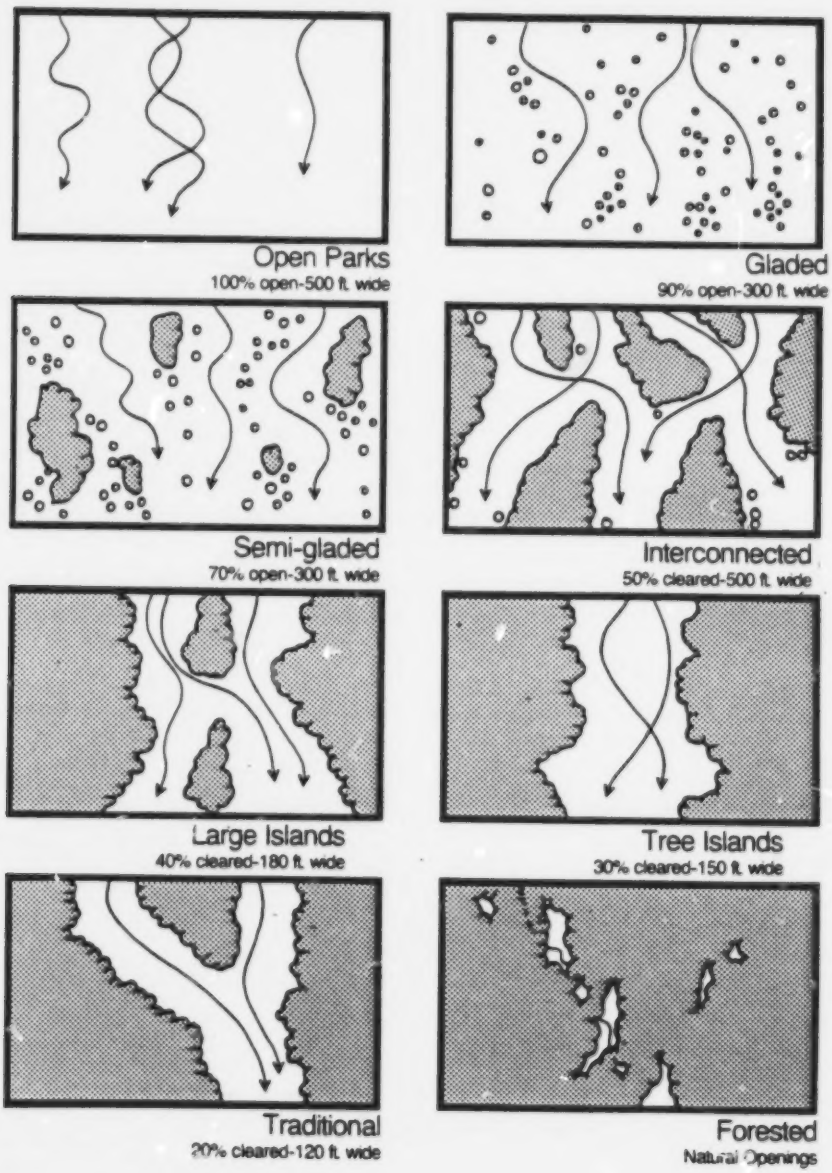
- moguls
- ski trails through treed areas
- partially treed runs
- variable snow conditions (powder and packed)
- facilities for jumping and racing
- selective ski run clearing (see Figure 14).

FIGURE 14
Glading for Variation in Terrain

Glading
create unobstructed lines
leave groupings of trees
widen for skier control
avoid single trees as possible safety hazard
Ski Run with glades
ski run through heavy timber or steeper areas
gladed opening
maintain way for packer
utilize natural openings

A variety of ski trail layout concepts is shown in Figure 15.

FIGURE 15
Ski Trail Layout Concepts



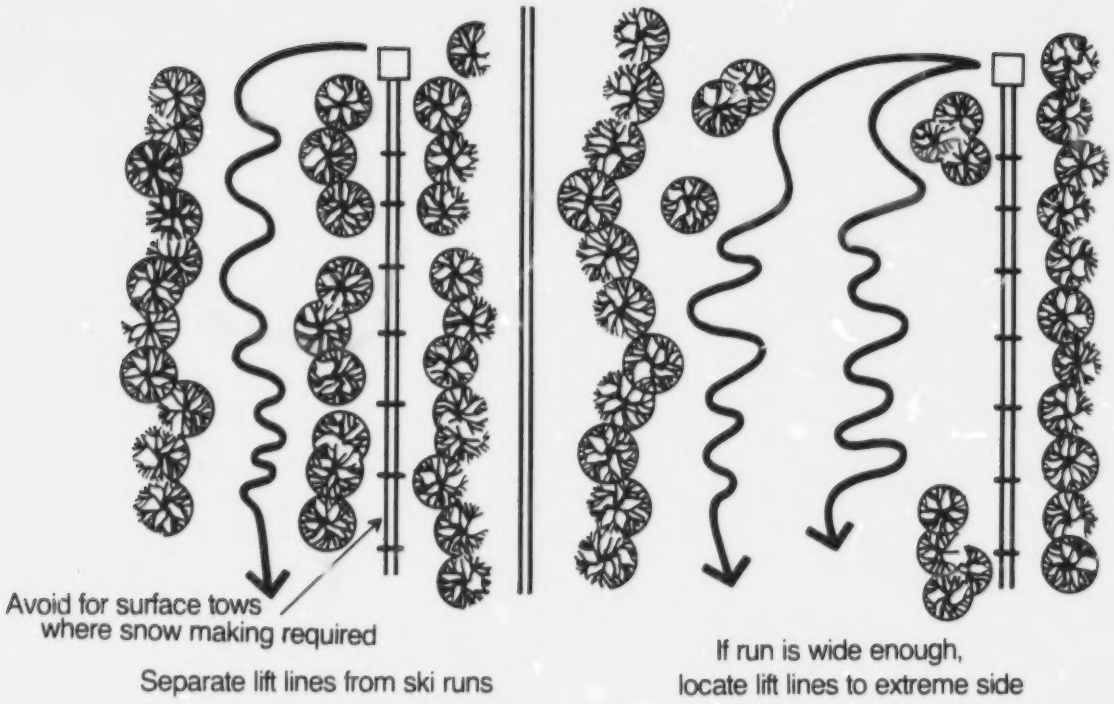
SOURCE: "National Forest Landscape Management Ski Areas, Volume 2, Chapter 7", USFS.

In providing variable ski terrain, care should be taken to avoid any traps, cliffs or dangerous changes in terrain. Possible ski runs or trails should be studied unde both summer and winter conditions. Blind spots and dangerous areas should be excluded, particularly from the high capacity and beginner slopes.

Avalanche hazards must always be considered, especially in higher alpine areas. Any unavoidable avalanche areas should be clearly marked and the slide hazard controlled. An avalanche expert or snow engineer may be required to evaluate possible avalanche areas near ski runs.

Proper trails cutting can eliminate a number of skiing mishaps. Some means of separation should exist between ski runs and tow lines. This can include a buffer of trees (see Figure 16) or some form of fencing. Signs should emphasize the dangers of skiing across the lift line.

FIGURE 16
Separating Runs from Lift Lines


Avoid for surface tows
where snow making required
Separate lift lines from ski runs
If run is wide enough,
locate lift lines to extreme side

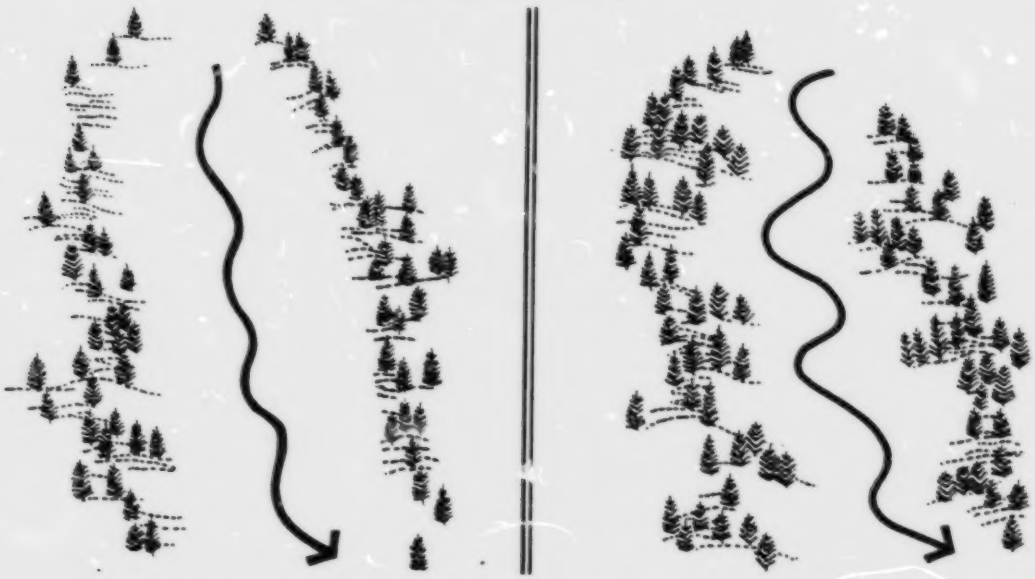
If advanced runs meet with beginner trails these should be widened and signed accordingly.

The aesthetics of a slope make skiing much more enjoyable. One method of creating a more pleasant visual effect is to soften sight lines by avoiding harsh, abrupt cuts into the landscape. This is achieved by feathering the wooded stand along the sides of the ski runs (see Figure 17.

FIGURE 17

Ski Runs

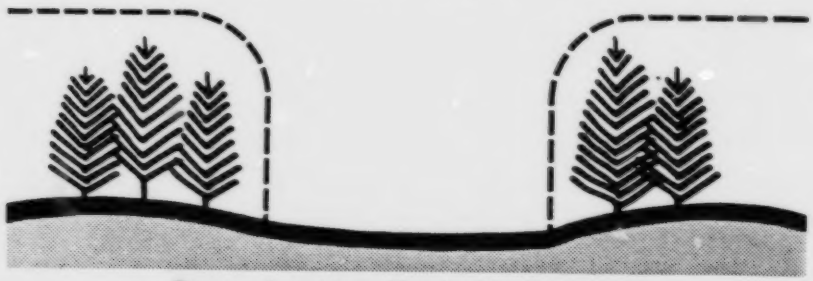
Feathering Technique



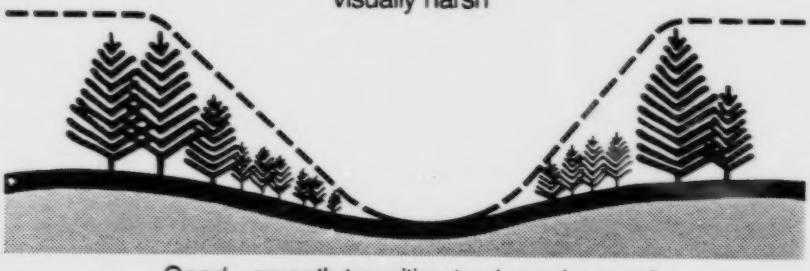
without feathering

with feathering

Aesthetic Considerations



Poor - abrupt transition to cleared ground
visually harsh



Good - smooth transition to cleared ground
visually softened

3.03 Lifts and Tows

The information contained in this chapter is for general guidance. A qualified engineer must be consulted to review specific lift and tow designs.

Basically there are four principal categories of lifts.*

i) Aerial Tramways

These have large cabins which can accommodate large numbers of people. Several in U.S.A. and Canada carry 120 people at speeds up to 7 m/second. They can be double reversible, having two carriers which oscillate back and forth between terminals on two paths of travel - one up and one down, or single reversible tramways having a single carrier which moves back and forth, between terminals on a single path of travel.

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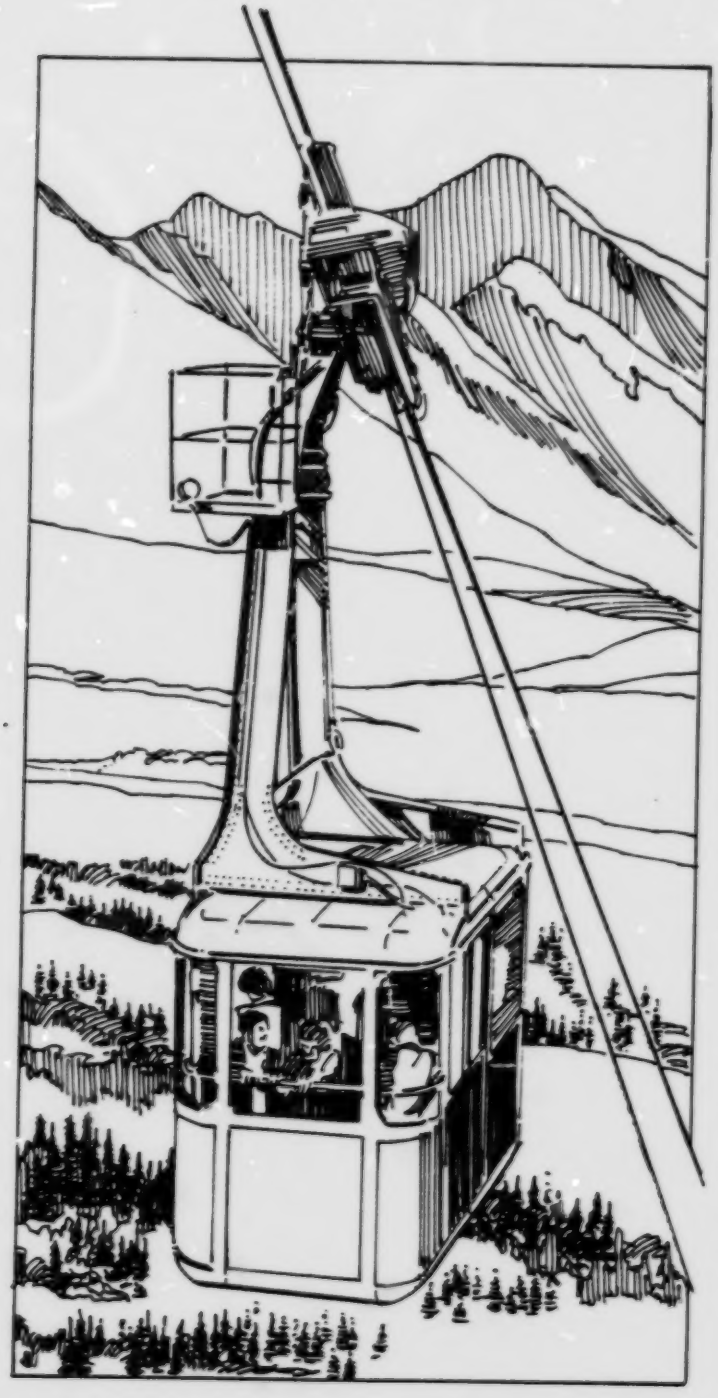
* From "Ski Resort Planning and Development".

Aerial Tramway



Drawing from Photo Courtesy of Jasper Tramway

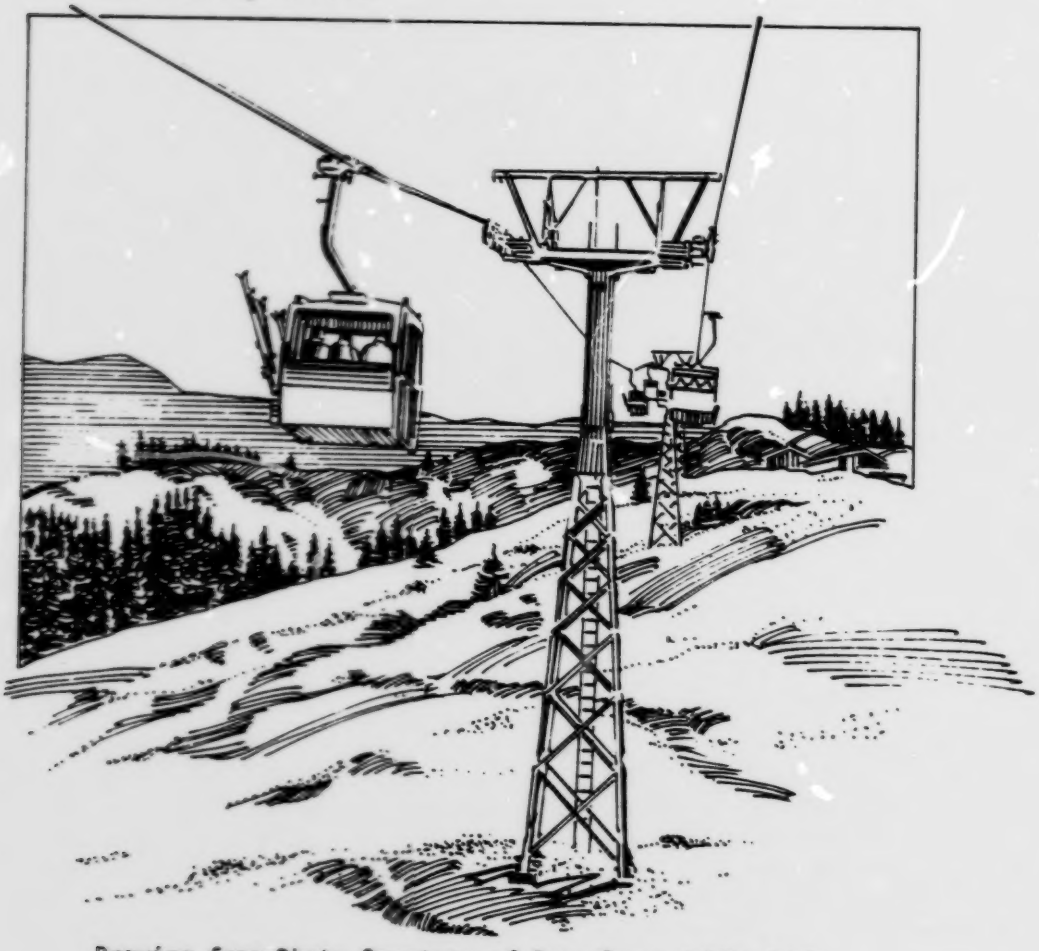
ii) Aerial Lifts

Aerial lifts include those aerial passenger tramways in which passengers are transported in carriers that are not in contact with the ground or snow surface and in which the carriers circulate around a closed system activated by a wire rope. The carriers make U-turns in the terminals and move along generally parallel and opposing paths of travel.

Sub-classifications of aerial lifts consider the carrier used.

Gondola Lifts:

The type of aerial lift which transports passengers in small carriers or gondolas is called a gondola lift. The system may be bicable or monocable; it may vary and carriers may be open or enclosed. Carriers accelleration in the terminal areas may be by gravity or by powered launching devices.



Drawing from Photo Courtesy of Doppelmayr Lifts Ltd.

Chair Lifts:

The type of aerial lift which transports passengers in chairs is called a chair lift. Most systems are continuously circulating, monocable types using permanently attached, open chairs for two persons. It should be noted that three and four-person chairs are available.

Drawing from Photo Courtesy of Doppelmayr Lifts Ltd.

Similar Equipment

Several variations of the aerial lift exist which do not qualify precisely as gondola lifts or chair lifts. For example, the skimobile transports passengers standing in cars which ride on a rigid structural support system and are propelled by a wire rope. Other systems involve enclosed cabin carriers, running on rails or guides, which detach from a continuously, moving haul rope at loading areas.

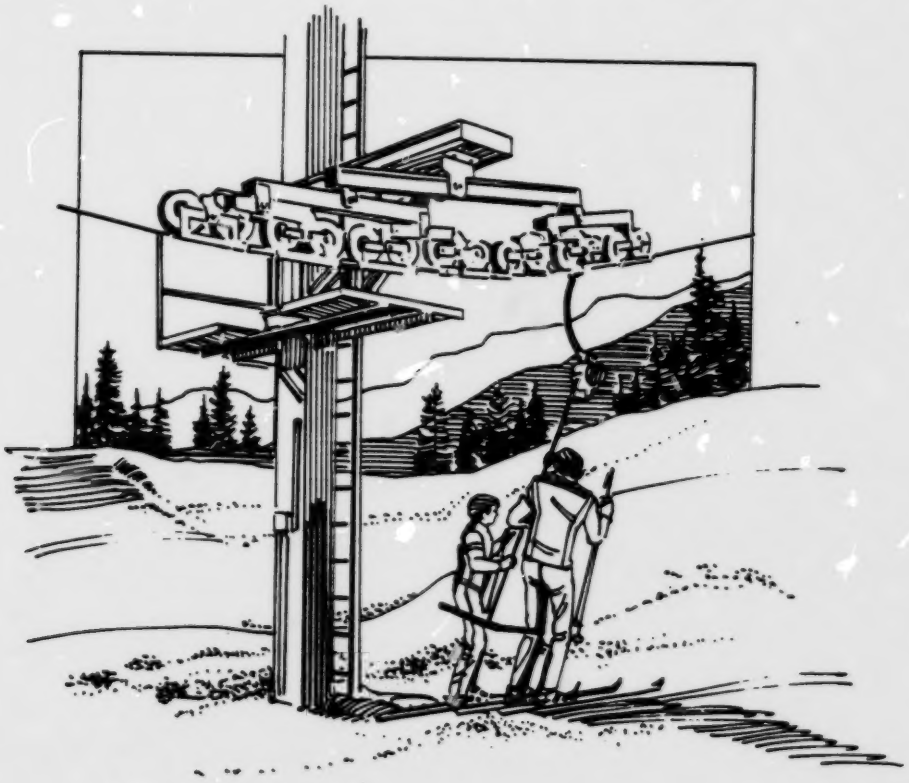
iii) Surface Lifts

Aerial tramways which propel passengers by means of circulating overhead wire rope while they remain in contact with the ground, snow or (rarely) water surface are called surface or traction lifts. Travel is generally limited to one direction. Connection between the passengers and the continuously moving haul rope is by means of a towing outfit attached to the rope. These lifts are most frequently encountered in ski areas.

Sub-classifications consider the type of towing outfit used.

T-bar Lifts:

A T-bar lift is a surface lift in which the towing device connecting the haul rope and passengers is shaped like an inverted T. Passengers stand on each side of the T stem. These lifts are built to accommodate two passengers and occasionally, four passengers.



Drawing from Photo Courtesy of Doppelmayr Lifts Ltd.

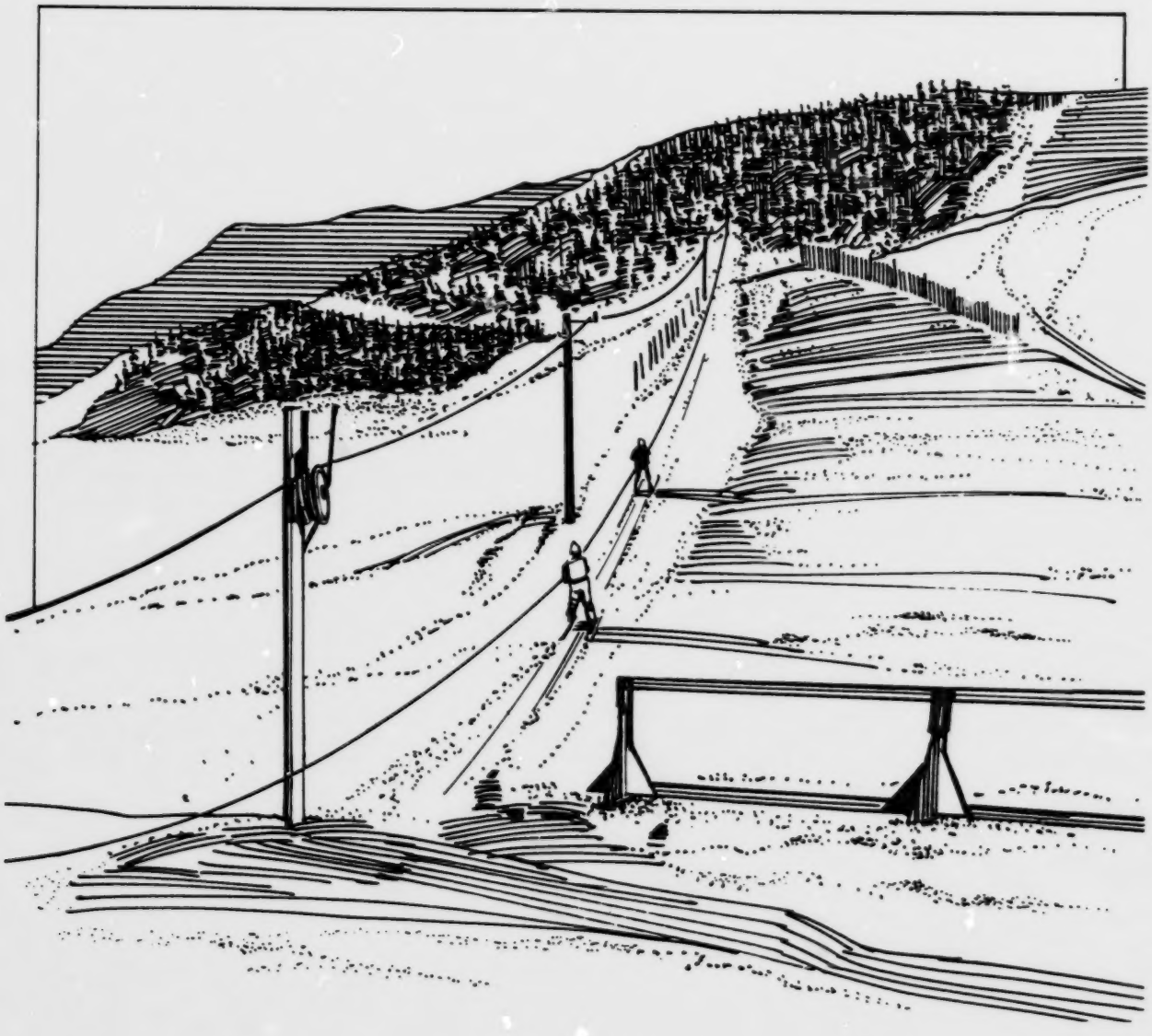
Platter Lifts:

The type of surface lift which the device connecting the haul rope and the passenger is a single stem with a platter or disc attached to its lower end is a platter lift. The passenger stands astride the stem. The type is frequently referred to as a Poma lift, after an early major supplier, or as a disc lift.

Drawing from Photo Courtesy of Doppelmayr Lifts Ltd.

iv) Tows

Tows are considered to be aerial passenger tramways only in the broadest sense. A tow is a conveyance on which a passenger grasps a circulating haul rope or a handle or portable gripping device attached to a circulating haul rope. Passengers remain in contact with the ground or snow surface. The upward travelling haul rope remains adjacent to the passengers' track at an elevation which permits them to maintain a grip on the rope or handle. Tows are generally unidirectional and the return lines of the continuously circulating haul ropes may be elevated and removed from the passengers' path.



Drawing from Photo Courtesy of Valley Ski Club - Castor

Sub-classification of tows consider the material of which the haul rope is constructed.

Wire Rope Tow

A metallic haul rope with permanently attached handles or grips distinguishes this type of tow.

A further sub-classification of tows considers the ease with which they may be relocated. The term "portable tow" may be used; however, many codes and standards do not recognize or make alternate provision for a portable tow used in public operation.

Fiber Rope Tow

This tow has a haul rope of natural fiber, such as manila, or synthetic fiber, such as nylon or polypropylene. A typical installation has springs to maintain rope tension in the bottom drive terminal and a takeup assembly in the upper terminal.

Design and Construction of Rope Tows

Rope tows can be placed on any smooth, even snow covered path up the fall line. It is advisable to have the tow line separated from the ski runs by a buffer such as trees, fencing or a berm to prevent skiers from skiing into it, as mentioned previously.

Proper installation is determined by the sag or dip in the catenary of the rope strung up along the proposed lift line (see Figure 18). The tension or amount of pull on the two ropes, can adjust this sag. Minimum rope pull prevents the rope from slipping on the drive pulley or sheave and excessive rope pull causes early rope wear and stretch. The required shape of a slope is found by placing a catenary line over the tow route.

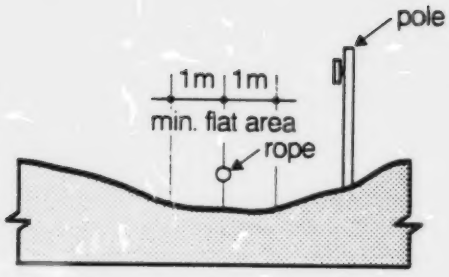
The length of the rope tow is determined by:

- the rope stretch (limits the length to 366 m (1,200 ft); and
- the maximum amount of time a skier can be expected to hold the rope (one minute).

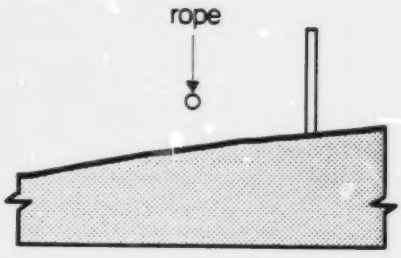
Exceptions can be made, but it should be remembered that it is very difficult for some skiers to hold on to a long, steep rope tow for a long period of time.

Tow speeds can vary from 11 km/hr (7 mph) for the novices, to 24 km/hr (15 mph) for experts only. The speed generally used is 16-19 hm/hr (10-12 mph). More shutdowns and accidents are apt to occur if the rope is moved at a higher speed.

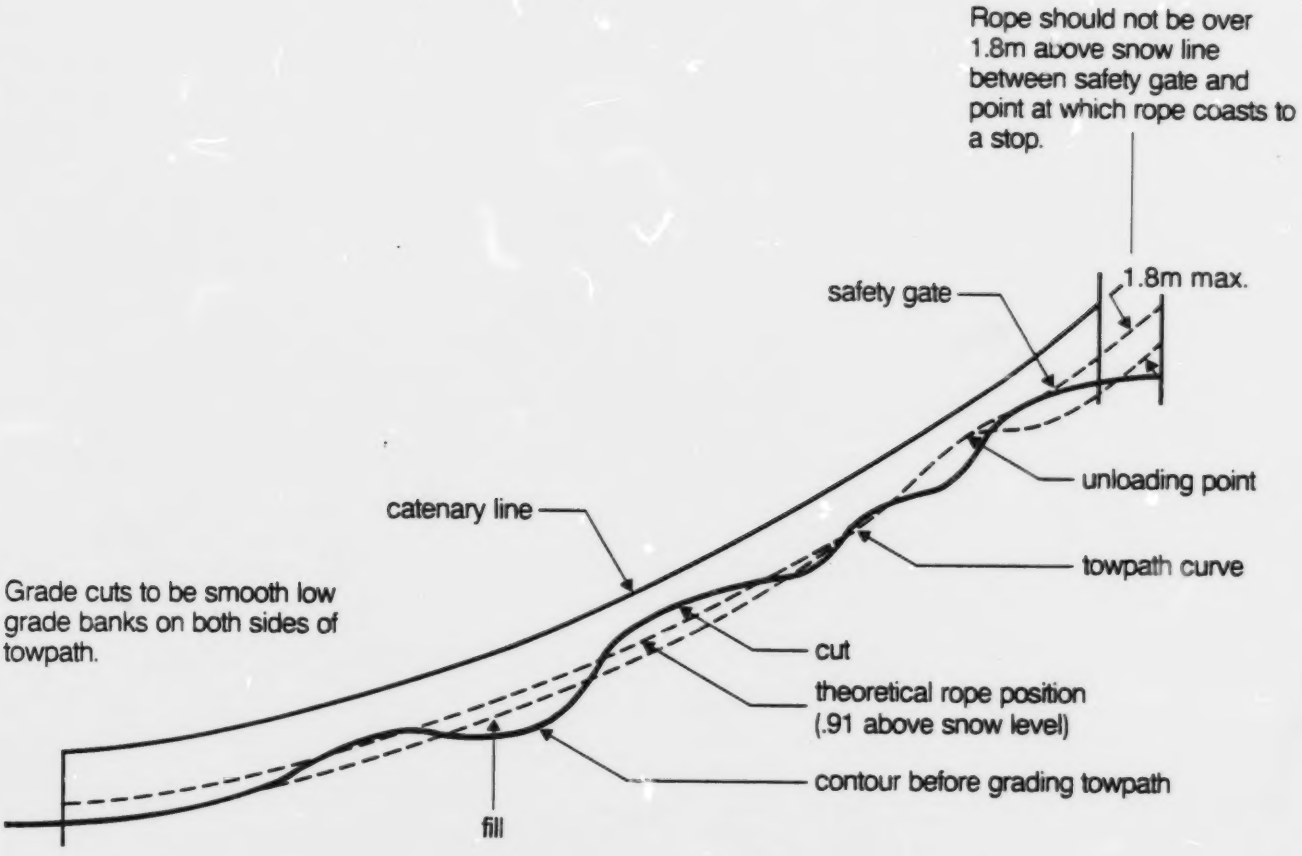
FIGURE 18
Rope Tow Path



Transverse section through towpath

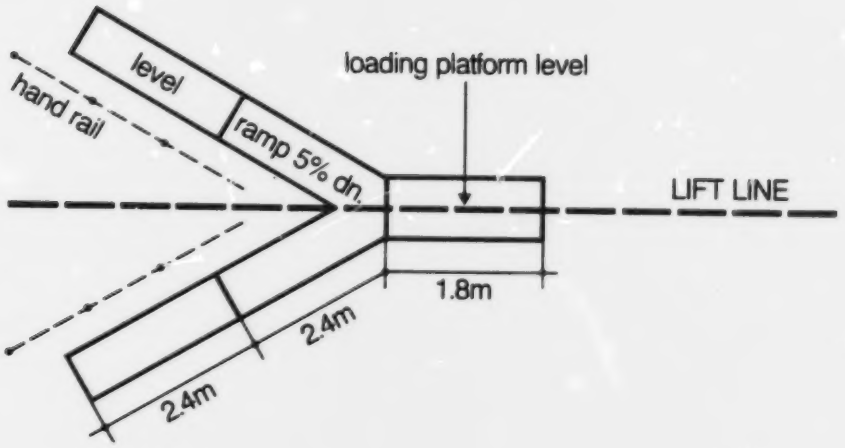


Transverse section unloading point looking up hill


Rope should not be over 1.8m above snow line between safety gate and point at which rope coasts to a stop.
1.8m max.
safety gate
unloading point
catenary line
towpath curve
Grade cuts to be smooth low grade banks on both sides of towpath.
cut
theoretical rope position (.91 above snow level)
contour before grading towpath
fill

The areas of loading and unloading are the most common places for falls or injuries incurred on ski tows. Loading and unloading areas must be carefully designed. There should be a gradual change in incline from the loading area to the slope itself and again to the unloading area. Grading of the snow cover can produce a slight downhill grade to the level loading platform (see Figure 19).

FIGURE 19



The unloading area should be sloped slightly downhill away from the tow rope to a level area on the sides (see previous Figure 18). Properly placed and adequate signage is important for release. A rope tow line will continue to rise upwards therefore the track should also continue upward after the unloading point to prevent a skier, who has failed to release from being lifted in the air (see again Figure 18). Tows can be loaded from two sides instead of one. This improves the load distribution on the tow line (see again Figure 19). Rather than have one skier lineup, two shorter ones on each side of the lift loading area, are preferable.

A safety gate should be properly placed, immediately after the unloading terrace, allowing enough area for the skier to be safely carried to a stop, after tripping the safety gate (see also Section 4.06).

(a) Power or Drive Units

The power unit for a tow is dependent on the energy sources available. A variety of machines can be used for a rope tow. They include electrical, gasoline, diesel or steam engines. The most common engines are the electric and gasoline.

i) Electrical Motor:
- most common source of power for a lift
- if power is locally available, it is the most economical, costs however could be high if transmission lines must be constructed
- electric drives could be three phase 220/440 V
- three phase motors cost less than equivalent capacity, single-phase motor - the cost of single phase motors over 5 H.P., makes them uneconomical
- electric drives with horsepower requirements for various lift lengths and skier loads must be considered

ii) Internal Combustion Gas Engine:
- power takeoff drives using a tractor are the least expensive power sources
- the tractor can be used for other uses when the tows are not operating
- tractor can be rented
- tows still require 120 V power source to operate safety devices

(b) Drive Location

The drive unit for the rope can be placed either at the bottom or the top of the tow. The most economical location for the drive unit is at the top because of safe, trouble-free operation, maximum efficiency, long rope life and minimum wear and stress on the equipment.

A number of hills do have bottom drive location because it is more convenient to install or because physical conditions made it impossible to place the drive at the top of the tow.

There are a number of disadvantages to the bottom location. These include:

- the rope must be kept at a higher tension to prevent slippage of the rope in the drive sheaves
- tension control must automatically compensate for skier loading with counterweight rigging
- the rope is flexed sharply under high tension over a variety of sheaves and tension equipment, resulting in higher internal rope wear

- with the higher tension to prevent slippage in the drive sheaves, for normal skier loading, the rope may exceed the breaking strength
- bottom installation requires much stronger sheaves and post members than corresponding top hill installation
- it is more difficult for the two operators to observe skiers and maintain safe operation

(c) Power Transmission - Speed Reduction

There are three alternatives for reducing speed:

i) Belt Drive:
- does not have positive drive or exact velocity ratio due to slippage
- could be used where overloading may occur as a safeguard, just as a slip coupling is used

ii) Chain Drive:
- more compact than belts
- use double stand roller chains for extra margin of safety
- sprockets 18 to 24 teeth are desirable, and about 500 r.p.m. sprockets with less than 25 teeth should be heat treated to 35 to 45 of Rockwell C hardness scale

iii) Automobile or Truck Transmission:
- average auto transmission gear ratios are: 2.5/1 in first; 1.6/1 in second; 1:1 in third with equivalent speeds of 8, 12 or 19 km/hr (4.8, 7.5 or 12 mph)

(d) Counterweights

Counterweights function as tension apparatus that take up slack due to rope stretch and cushion any shock loads in the line. Design considerations include:

- placement either at the top or bottom of the tow - a smaller counterweight is used at the bottom because of greater tension at the upper terminal
- take-up should not be of the fixed type, which eliminates the cushioning effect for shock levels
- take-up should pick up at least 10% of the tow rope length
- no take-up arrangement is required for a top drive rope tow because the thrust of the rope downhill provides sufficient tension in the drive sheaves
- normal operating tension should be determined in conjunction with rope and equipment suppliers.

(e) Drive Sheaves

The drive or idler should be at least 30 times the diameter of

the rope, i.e., for 25 mm (1 inch) use 750 mm (30 inch) diameter sheaves; for 28 mm (1 1/8 inch) rope, use 915 mm (36 inch) sheaves.

For maximum rope life and minimum rope slippage, a variety of options are available for the types of rope tow sheaves:

i) Commercially Available Multi-Purpose "V" Belt Sheaves:
- for 25 mm (1 inch) rope "D" Section "V" Belt sheaves;
- for 37 mm (1 1/2 inch) rope "E" Section "V" Belt sheaves; and
- at least one idler sheave is required for two partial wraps.

ii) Built-Up Plywood Drive Sheaves with Turned Grooves:
- require idler sheaves
- very abrasive, decreasing rope life

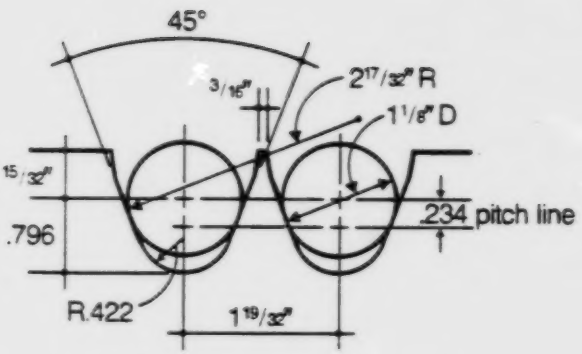
iii) Commercially cast drive sheaves with a rubber or neoprene groove liner.

iv) Truck or tractor tire with a rope groove cut into the thread, or with a strip vulcanized onto the tire:
- has advantage of simplicity
- one partial wrap is required
- no ilder sheaves required
- least expensive alternate (see Figure 20).

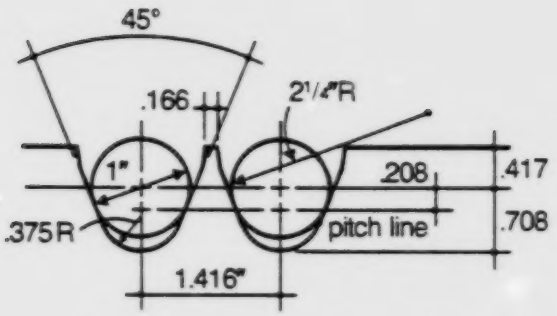
(f) Return Rope Idlers

The most economical rope idlers are drop centre front auto wheels, purchased complete with spindle and dust caps. These return idlers are usually supported on telephone poles. Proper alignment of idler rope is important to minimize rope rotation and wear.

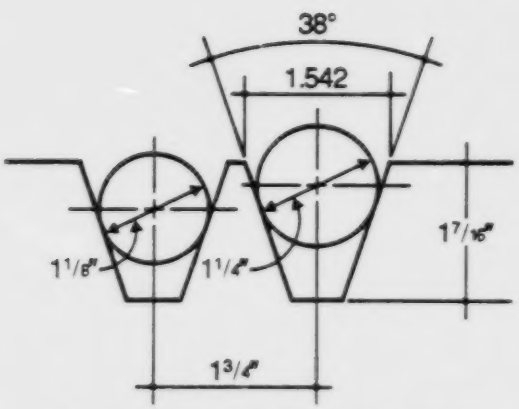
FIGURE 20
Rope Transmission Grooves



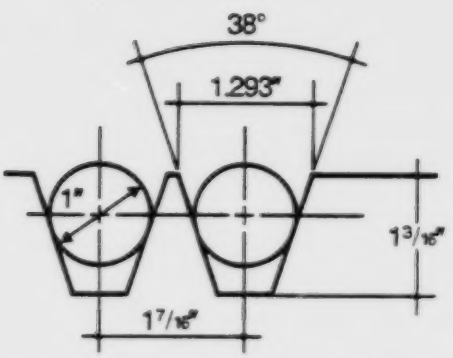
Standard rope transmission groove ideal for 1 1/8" ski tow rope



Standard rope transmission groove ideal for 1" ski tow rope



Standard groove for 'E' sect. 'V' belt satisfactory for 1 1/8" and 1 1/4" ski tow rope



Standard groove for 'D' sect. 'V' belt satisfactory for 1" ski tow rope

SOURCE: 1976 Edition "Ski Area Planning".

(g) Tow Ropes

At present there are two basic types of tow rope composition:

- Manila - low initial cost, short life, 4% stretch
- Monofilament polypropylene - three times the life expectancy, more water repellent, easier on ski clothing, less abrasive, manufacturer will advise on stretch. Combination polypropylene and multiplex polyester rope is now also available with superior qualities.

(i) Rope Properties

TABLE 16
Tow Rope Properties

ROPE TYPE	BREAKING STRAIN					
	25mm± (1")		28 mm± (1 1/8")		30 mm± (1 3/16")	
	kg	lbs	kg	lbs	kg	lbs
Manila	4,050	9,000	5,400	12,000		
Polypropylene	5,513	12,250	7,785	17,300		
Super Poly-Propylene (Dacron Coated)					12,600	28,000

NOTE: Polypropylene weighs less than its equivalent size in manila.

SOURCE: Canadian Western Cordage Ltd.

Various new rope types and units are being developed with improved strength and longer life.

A 28 mm (1 1/8") rope has been found to be more suitable for tow ropes because the larger diameter makes it easier to grip, and more contact area is provided with the drive sheaves.

Examples of recommended operating speeds for various types of tows are:

	m.p.s.
Reversible tramway	10.0
Gondola lift	4.0/ 5.0
Continuously circulating chairs	2.3/ 2.5
Continuously circulating double or tripple quad chair	2.0/ 2.2
Detachable chair	4.0/ 5.0
Surface platter lift	2.0/ 2.0
Surface t-bar	3.0/ 4.0
Rope tows	2.0/ 2.5

INFORMATION SOURCE: Doppelmayr Lifts Ltd.

Selecting a Supplier

Once the decision has been made on the type of lift or tow to be installed, the next important step is getting quotations and selecting a supplier.

While initial cost is obviously a consideration, it should not be the deciding factor. There are very few other situations where a single piece of equipment is carrying such a large number of people under conditions so susceptible to accidents, caused either by malfunction or the actions of the passengers. In the case of aerial lifts an accident is quite likely to cause serious injury or death.

Following are some of the criteria which should be applied when deciding on a supplier.

1. Are they a well-established reliable company, in a strong financial position?
2. Do they have a sound background in the design and manufacture of this type of equipment?
3. Do they have a good warranty, and the reputation of backing it up?
4. Will they refer you to other customers using their equipment?
5. Do they supply sufficient and competent field supervision of installation?
6. Are their payment arrangements suitable and do they include a holdback until after a month or two of operation?
7. Will they accept a penalty clause for late delivery?

8. Does their contract specify exactly, and in detail, what equipment and services you will be getting?
9. Will they provide technical personnel to help finalize the lift line location and the layout of loading and unloading areas?

Construction*

Many small lifts and tows are installed by construction crews recruited locally by an area operator or owner. Construction can be done in this manner when proper drawings and construction procedures are under the periodic supervision of an engineer or experienced lift contractor. For major installations construction is usually carried out by contractors experienced in lift work. A certain amount of special equipment is involved and ski lift experience is essential.

In the past, most of the lifts were built on site, and buildings, towers and support structures were fabricated in the field from basic components. Some of this is still done today, but, increasingly, structures and machine assemblies come ready-made and assembled to minimize the time and skills required in the field. Field welding is curtailed or completely eliminated. Pre-assembled drives eliminate the need for skilled fitters to assemble and align machinery. The uses of ready-mix concrete has virtually replaced the previous procedure of mixing concrete at the site of each structure.

Ski lift design and construction is influenced, if not dictated, by limitations on access to the site. Restrictions vary from unlimited access for wheeled and tracked vehicles driven directly to each terminal and tower site to situations in which there is no road access and all materials must be flown in by helicopters. A combination of trucks and helicopters is often employed, thus making use of existing access roads, while eliminating the need for new road construction.

The construction cableway or tramway is an alternative construction method used frequently in Europe and offering advantages under certain conditions of terrain.

Concrete for foundations and structures is nearly always plant mixed. Delivery to the site by ready-mix truck is most common when road access is available. Pumping to tower sites from strategic points along a line is feasible and economical. Helicopter transit is fast becoming increasingly competitive from a cost-in-place standpoint.

Wintertime construction using over-the snow vehicles to minimize damage to fragile alpine terrain has been done with some success.

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* From "Ski Resort Planning and Development".

3.04 Safety Equipment

Safety Gate

The safety gate is a very important safety device in a tow system. It is located near the drive, or the return sheave. The purpose of the safety gate is to break the circuit and stop the power drive if a skier is carried past the unloading point. The rope must stop before the skier is half-way between the safety-gate and the nearest piece of equipment under the following basic conditions:

- there is only one very small skier on the rope
- the rope is travelling at top speed

otherwise in accordance with the prevailing National Standard of Canada for Passenger Ropeways regulations.

Three suitable types of safety gates are:

- aluminum rod covered with plastic or rubber tubing, supported in fuse holders. One fuse holder anchored facing uphill, the other fuse holder facing downhill
- length of wire with battery clips at each end clipped on the circuit at end posts

- length of wire with duplex plug on each end, plugged into a receptacle mount on a post on each side of the line

A safety gate should break the circuit at an instant touch and stop the tow. The safety gate is part of an integrated closed circuit system with the drive power source, whether electric or internal combustion. The system is centred around a spring loaded solenoid relay switch. If the gate is opened, the relay circuit is broken and the power switch is opened, stopping the drive (see Figure 21).

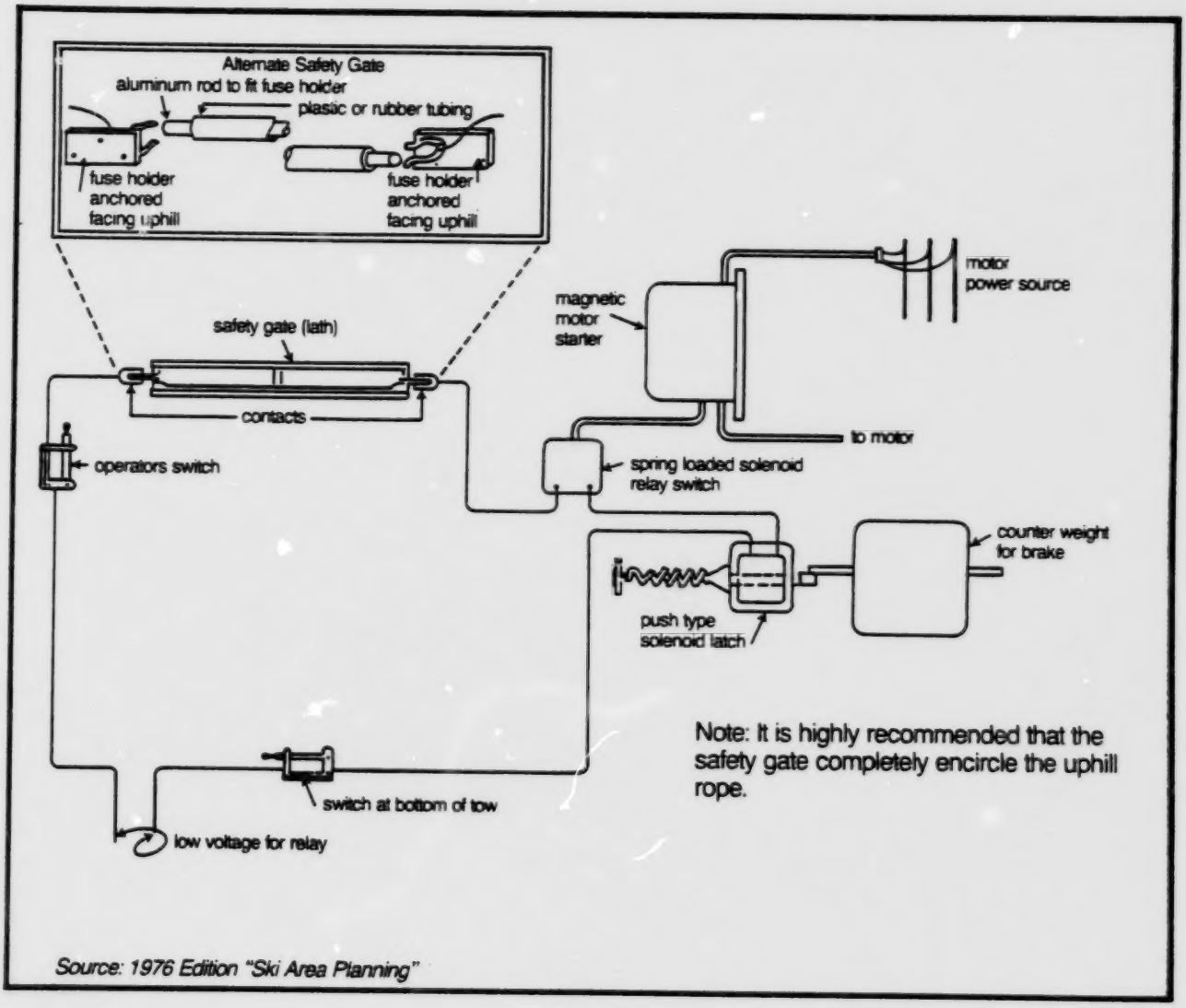
To prevent the possible by-pass at relay switch points, the relay circuit must be wired with wire conductor, in series. The circuit wire must postively pass through the safety gate.

Safety Brake

The safety brake is the mechanism which stops the tow quickly after the safety gate has been tripped. Also, the safety brake keeps the rope and skiers from sliding down the hill when the power is cut. There are three common alternatives for manufacturing safety brakes:

FIGURE 21

Closed Circuit Safety Gate


Alternate Safety Gate
aluminum rod to fit fuse holder
plastic or rubber tubing
fuse holder anchored facing uphill
fuse holder anchored facing uphill
safety gate (lath)
contacts
operators switch
magnetic motor starter
motor power source
to motor
spring loaded solenoid relay switch
counter weight for brake
push type solenoid latch
switch at bottom of tow
low voltage for relay
Note: It is highly recommended that the safety gate completely encircle the uphill rope.

Source: 1976 Edition "Ski Area Planning"

- by using an automotive parking brake on the tow drive. This brake is activated by a counterweight hung from the brake lever. The counterweight is supported by a spring loaded, push type, solenoid latch in the safety relay circuit and in series with the power switch relay (see again Figure 21).
- by an electric brake automatically applied when the power is cut off. Braking force is by means of an adjustable spring counteracted by the force of a solenoid or centrifugal thauster. When the power is cut, the spring-activated brake shoes are applied.
- electric power drive units can be ordered from the manufacturer with a brake internally mounted.

The first two alternatives can be used with either electric or gas drive units. The first alternative is the least expensive, with the third the most costly.

Safety Netting

Safety netting is being used more than ever, some types and locations are:

- Triangle nets - these are designed to prevent accidents when a skier falls in front of a chairlift or ski-lift tower. Distance between the bottom of the tower and the net should be designed to suit maximum skier speed, to permit safe deceleration.
- Chairlift nets - under gondola or chairlift loading ramps these nets protect skiers and staff from accidents caused by inexperience or negligence.
- Marking and slope edging nets - marking nets can instantaneously close off a trail in case of danger; for instance in case of possible avalanche, or when grooming machines are working over trails. They will also easily divide beginner and expert trails. Slope edging nets perform similar functions, but are stronger.

Lifts

Safety equipment for aerial systems are usually integral with the control system. Safety lines or gates, however are sometimes installed along with safety netting. Your lift engineer and/or supplier will advise on regulations and manufacturers recommendations.

3.05 Snow Making

At present there are numerous makes and models of snow making apparatus available. The two basic types of systems are the:

- Airless or low pressure system - this really means a low or non-compressed air supply system.
- Air or high pressure system - this system uses water and compressed air.

When selecting snow making equipment, the following factors should be considered:

- portability - how easily can the unit be moved about on the hill
- costs - operation, capital and installation
- serviceability
- power and material requirements of the equipment
- slopes requiring snow making equipment

If a decision has been made to install snow making equipment then pipelines are buried, usually along the runs, one carrying water and if a high pressure system is to be used, another pipe carrying compressed air.

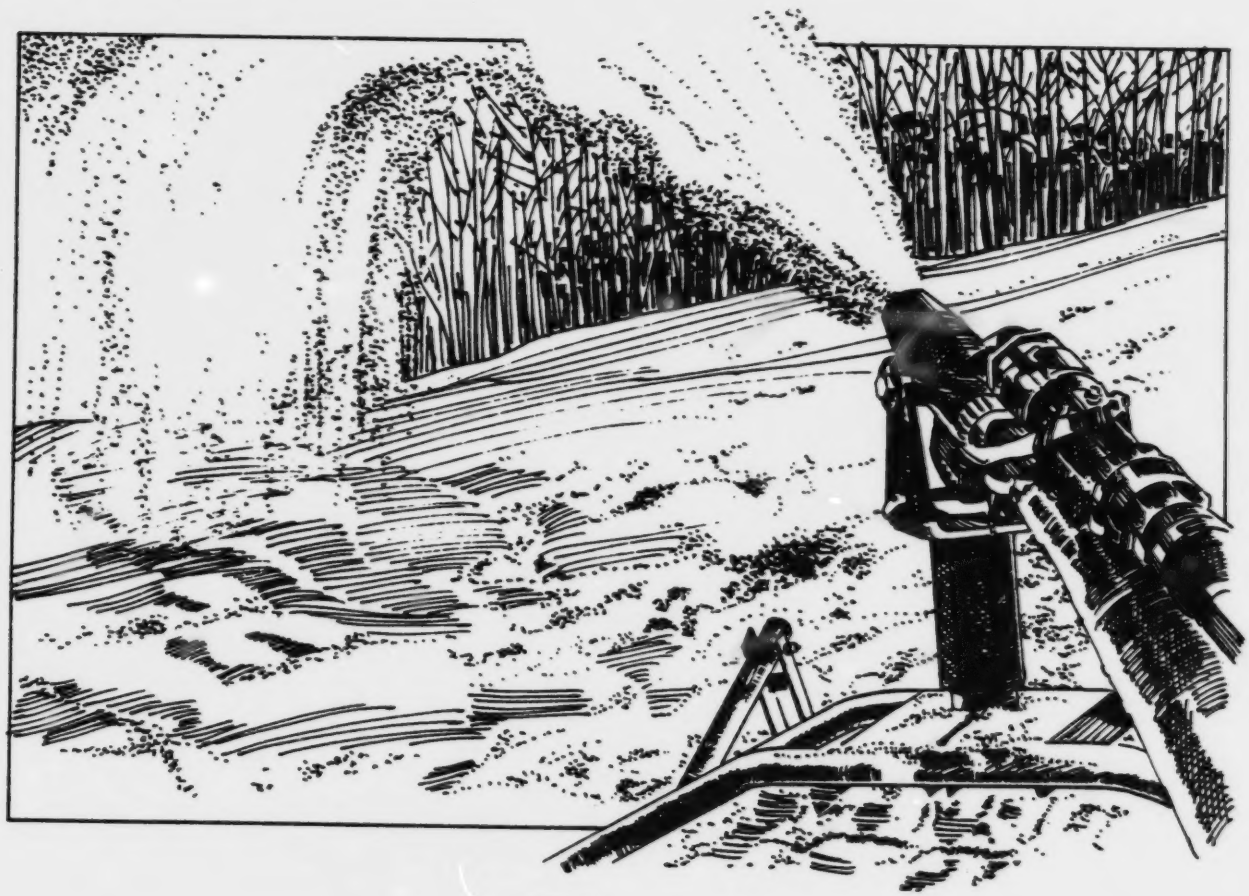
i) Low Pressure System - Where fans are operated on the slope. The disadvantage of this system is the heavy equipment to be operated on the slope. The advantages are that this system uses less electrical energy and is comparatively quiet.

LOW PRESSURE SNOW MAKING SYSTEM
Drawing From Photo Courtesy of
Alpine Snow Making Equipment Ltd.
Canadian Distributor for HEDCO
Snowmakers

ii) High Pressure System - Rapidly expanding compressed air rips off water particles in an open type nozzle and propells the particle through the air at much higher velocities than in the Low Pressure Systems. The High Pressure System generally utilizes light equipment on the slopes and is recognized as being the most effective at higher temperatures. They are the noisier systems and bigger energy consumers. Electrical power is usually installed underground to the compressors, which are generally located about the middle of the area to be covered with snow. Special noise insulation is necessary in the compressor rooms.

HIGH PRESSURE SNOW MAKING SYSTEM

Drawing of Photo Courtesy of Alpine Snowmaking Equipment Ltd.
Oakville Ontario



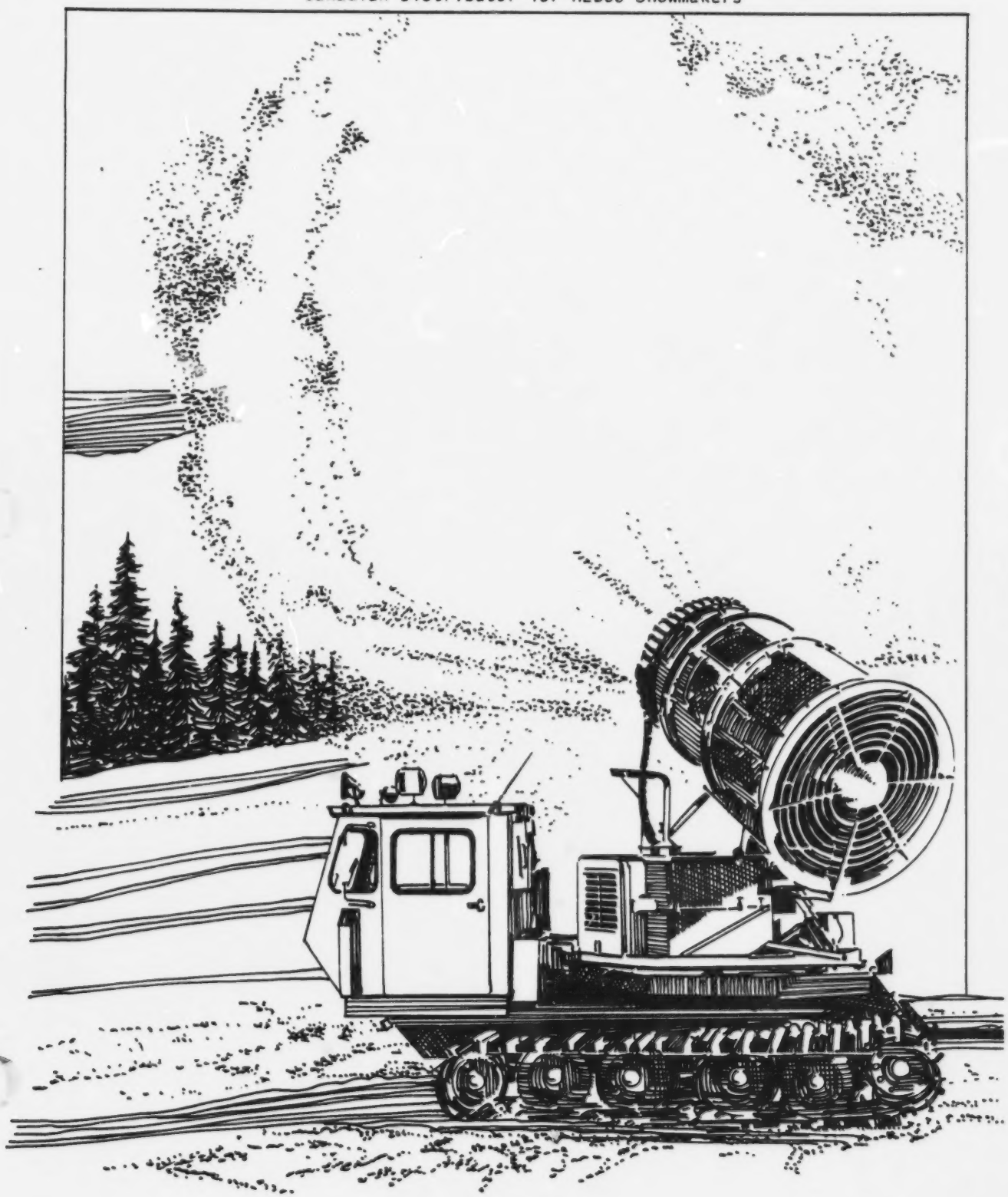
As snow making is a heat rejection process, it follows that the coldest water and air possible, should be used. Also, compressed air delivered to the nozzles should be as cold as possible. Although snow can be made at freezing point, it is not regarded as feasible above $-2^{o}C$. In fact the colder it is, the more efficient is the snow making process.

Complex systems have been developed using computers to regulate the air and water usage, even making the necessary adjustments to nozzles to allow for temperature and humidity. Prior to this the capabilities of the "snow makers", the men who operated the equipment, were probably the biggest single factor affecting snow making efficiency.

Self propelled high output snow making vehicles have recently come into use and should be carefully considered in any economic analysis on a life cycle cost basis.

SELF PROPELLED SNOW VEHICLE

Drawing of Photo Courtesy of Alpine Snowmaking Equipment Ltd
Canadian Distributor for HEDCO Snowmakers



Machine made snow is more durable than natural snow because there is more moisture in it. For most ski area requirements 476 kg/m3 (30 lb/ft3) is an average density produced by most systems. Natural dry snow can be as light as 159 kg/m3 (10 lb/ft3).

As snow making is one of the most expensive areas of resort operation, achieving maximum efficiency is vitally important. Variations in efficiency between different systems of up to 50% can be found.

Often the lowest purchase price is actually the most expensive system to operate.

With the high cost of snow making, all methods of saving snow through tree planting, etc., should be investigated.

Selection of the snow gun is very important. Since most areas do not have the complex equipment necessary to do accurate gun tests, one approach is to request certified test reports from the gun manufacturers and another is to approach a number of areas that have run a number of guns over a considerable period of time and seek their results.

Table 17 shows the results of snow making tests using a variety of units.

TABLE 17

Recorded Valves - Panorama Snow Making System

SNOW MAKING UNIT MANUFACTURER/ MODEL	AMBIENT AIR TEMP.	RELATIVE HUMIDITY (I)	AIR PRESSURE IN PSIG OR TOTAL MOTOR	RECORDED AIR FLOW CFM	CALCULATED AIR FLOW SCFM	MOTOR AMPS (600V/ 3/60)	WATER FLOW (USGPM)	PANORAMA CREW COMPONENTS	CALCULATED AIR/WATER SCFM/USGPM	DENSITY GM/LITRE	NOISE LEVEL DRA	MICHEAL MANHART'S COMMENTS
SNOW PRO	-19.3	57.9		515.2	467.6		70.1	OK	6.7	480	95	SMALL PARTICLES, DRY
	-19.2	57.8	137 PSI	517.1	469.3		69.7	OK	6.7			
ATOM	-18.6	57.2	136 PSI	250.7	226.0		59.2	OK	3.4	484	96	SLIGHTLY WET, BIG PARTICLES
	-18.1	55.4	135.PSI	210.3	188.3		53.5	OK	3.5			
SMI:												
BOYNE-HIGHLAND	-16	51	15 HP			3X15A	69.1	OK				
			15 HP			3X15A	82.0	OK				
	-16	53	15 HP			3X15A	76.3	OK		444	80	
			15 HP			3X15A	75.7	OK				
ARLBERG JET	-18	54.6	131 PSI	400.1	348.6		111.6	OK	3.1	474	91	
LAR:												
ST. 100 - DOUBLE	-18	55	127 PSI	481	407.0		49.3	OK	8.3		110	DRY SNOW
SLOT NOZZLE	-17	55	127 PSI	538	455.7		42.0	OK	10.9			
SATURDAY NIGHT SPECIAL	017	55	127 PSI	733.1	620.9		80.8	OK	7.7	476	100	

TABLE 17 (Continued)

SNOW MAKING UNIT MANUFACTURER/ MODEL	AMBIENT AIR TEMP.	RELATIVE HUMIDITY (I)	AIR PRESSURE IN PSIG OR TOTAL MOTOR	RECORDED AIR FLOW CFM	CALCULATED AIR FLOW SCFM	MOTOR AMPS (600V/ 3/60)	WATER FLOW (USGPM)	PANORAMA CREW COMPONENTS	CALCULATED AIR/WATER SCFM/USGPM	DENSITY GM/LITRE	NOISE LEVEL DRA	MICHEAL MANHART'S COMMENTS
CROSS-COUNTRY	-17	53	122 PSI	230.4	188.2		26.6	OK	7.1			
	-17	51	123 PSI	263	199.9		25.4	OK	7.9	436	96	DRY SNOW
	-17	50	125 PSI	227	189.5		27.1	OK	7.0			
MUSKET - 2 (1000 NUZZLE)	-18	51	130 PSI	395.7	342.4		58.5	OK	5.9	460	96	
	018	51	130 PSI	396.0	342.6		58.4	OK	5.9			
SNOPRO	-15	53	139 PSI	570.1	524.4		62.9	OK	8.3	500		
	-15	52	136 PSI	513.0	462.5		69.5	OK	6.7			
SMI-320	-15	50	20 HP				64.5	RAIN		74		
	-15	50	20 HP				47.0	?	436			
	-15	50	20 HP				18.2	SNOW				
	-15	50	20 HP				18.1	SNOW				
	-15	50	20 HP				18.4	SNOW				
	-15	50	20 HP				18.4	SNOW				
	-15	50	20 HP				17.8	SNOW				
ALBERG JET	-14.3	51.3	91.8 PSI	561	355.3		62.0		5.7			DRY SNOW
	-13.9	54.0	91.9 PSI	559	356.3		61.8		5.7	440		DRIER SNOW
	-13.5	50.0	141.0 PSI	512	477.2		90.1		5.7			

SOURCE: Group Delta

In view of the variety of equipment and variations in efficiency along with need for suitable control systems you would be advised to consult with an independent engineering company who have specialized in snow making. Such consultants are listed in the CWSAA members directory.

For more detailed review of snow making equipment, design and installation procedures, see "Ski Resort Manual" (Ontario).

3.06 Signs

Proper and adequate signs are a key factor to the safety and success of a ski area. The signs should be concise and clear. Some of the important signs and their locations are:

SIGN	LOCATION	SIZE AND TYPE
Highway Exit Sign	- Turn-off major highway.	- Restricted to Department of Highways Standard Ski Hill Symbol.
Directional Sign to Ski Hill	- Along access roads, stating direction and distance.	- Large enough to be read from car night or day.
Entrance Sign	- At entrance to ski area.	- Large and clear with identifying symbols of the area.
Parking Area	- Along entrance road.	- Large enough to be read from the car.
Ski Shop Lift Ticket Sales Concession Restrooms	- At specific locations.	- Large enough for pedestrian traffic.
Ski Slope Classification	- At top of the ski runs and trails.	- Should use uniform symbols (see following article).
Tow and Lift Signs	- Where required: along lift route in lift lines near terminal. All safety devices should be well marked.	
Site Layout	- Near base facilities.	- Pictorial, showing layout of slopes, facilities and total site.

Proper signing at the tows and along tow lines can result in smoother, and safer tow operation. Some of the most common signs and their locations are.

SIGN	LOCATION(S)
"IF NOT FAMILIAR WITH USE OF TOW, ASK ATTENDENT FOR INSTRUCTIONS"	- Tow loading area.
"SAFETY GATE"	- Between unloading point and safety gate.
"PREPARE TO UNLOAD"	- Along tow line, 9 m-15 m (30-50 feet) before unloading.
"DO NOT SKI ACROSS LIFT LINE"	- Along a long tow line periodically between upper and lower terminal.

The following article concerning the need to standardize signage appeared in March 1984 edition of "Ski Area Management".

THE CASE FOR STANDARDIZED SIGNS

Western Canada has adopted ski signs widely used in Europe. Other area operators throughout North America need to evaluate this system.

by Jimmie Spencer
Executive Director, Canada West Ski Areas Association

In July 1982, the Canada West Ski Areas Association (CWSAA) board of directors established a committee to study existing signage in alpine ski areas of Canada, the United States and Europe, with the intent of introducing a standardized system in Western Canada. A study of all existing signage in ski areas of Western Canada was carried out between July and December, 1982. In January and February, 1983, the committee carried out an on-site survey of ski areas in Italy, Austria, Germany, Switzerland, France and the U.S.A. As a result, the committee is of the firm opinion that signing methods in North America would be considerably enhanced by utilizing parts of the European system which is already standardized.

Most alpine ski areas in North America currently have a conglomeration of signage which has accumulated over several decades, following trends and preferences of individual management. When viewing the industry overall, this ad hoc system detracts greatly from the sophisticated, professional image the North American ski industry is trying to present. Clearly, it is time for updating with a standardized system incorporated into a sign manual.

A sign is simply a medium of communication. In the ski industry, it can describe services, give directions, inform about the safe use of facilities, warn of hazards and regulate skiers actions to achieve management objectives. Currently, too many signs fail to communicate effectively. This can lead to misunderstandings which may result in accidents or unfavorable circumstances on the mountain, as well as creating a poor corporate image and inviting criticism.

Over a number of years, the European ski industry has developed a standard approach to signing. This approved system has been officially endorsed by the Federation Internationale de Ski (FIS) Safety Committee and fully adopted by all eight alpine skiing countries of Europe; Germany, Austria, Italy, Yugoslavia, Switzerland, France, Andorra and Spain. To encourage international conformity, CWSAA has now adopted the European standardized system with modified English translations. The system is based upon the use of symbols (pictograms) and/or schematic instructions, sometimes accompanied by simple wording, and standard

shapes and colors. Canadians are already familiar with this approach and rely upon this method for road traffic signs. Many federal and provincial government agencies have produced elaborate sign manuals based on this system for the facilities under their control, most notably national and provincial parks.

The rationale others have used for accepting standardized symbols can be applied equally to the Canadian ski industry. The main arguments in favor of such a system are:

1) Safety - People of all nationalities can better comprehend and interpret the safety/instructional message due to the simplicity and self-explanatory nature of the pictogram. If they have not encountered a particular symbol before, they are able to identify with the human activity and react quickly because of its simplicity. As symbols are more widely used, people will be more familiar with them and be able to recognize them worldwide. This is already being done by the introduction of internationally accepted traffic signs on which all licensed drivers are tested and experience daily on the road. In addition, many manufacturers use symbols on automobile dash panels to convey functions to the driver. These are excellent examples of the success of this approach.

2) Communication - Improved communication, minimizing misinterpretation, achieves management objectives better and will result in greater use satisfaction.

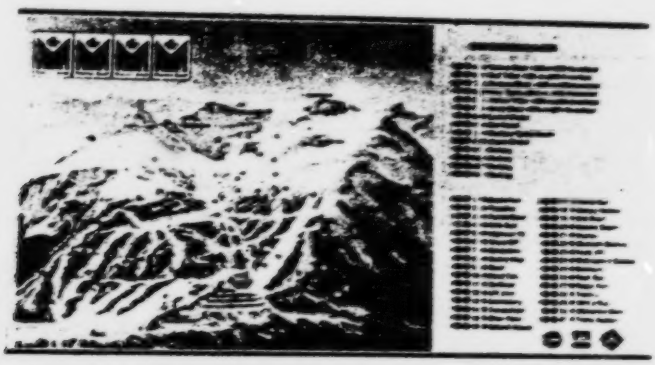
3) Simplicity - Pictograms are simple to acquire and easier to produce than wordy custom signs, thus reducing production costs and expediting the replacement of signs. They are also much less obtrusive in the natural setting where most alpine ski areas are located.

4) Tourism - Canada's economy relies heavily on international tourism and the ski industry is one of Canada's major winter tourist attractions. A professional, efficient image stemming from an effective standardized system is a necessary prerequisite for encouraging and holding the future international ski tourist market.

Sign Usage

Some European signs may seem obscure when viewed in isolation on paper. However, when kept in context with the facility to which they relate, the meanings become quite clear. The correct siting of signs and combination of symbols are very important and it is essential to spell out clear guidelines on such matters in a detailed sign manual. In addition to the use of standard symbols and wording CWSAA has accepted standard colors and dimensions.

Sign categories for alpine ski area activities can be divided according to their primary functions: general information, directional, instructional, warning, regulatory.



Marmot Basin, Jasper, Alberta. Sign by Sitour Productions Inc.

General Information: In all alpine ski areas, large or small, there is an immediate need to orient visitors to the ski terrain and resort facilities. It is recommended that all areas have a main panorama type display board at the base of the lifts and at any other main skier dispersement location on the mountain. Ideally, they should display dynamic information, showing ski runs, their relative degree of difficulty and whether open or closed, lift systems by type and other selected information.

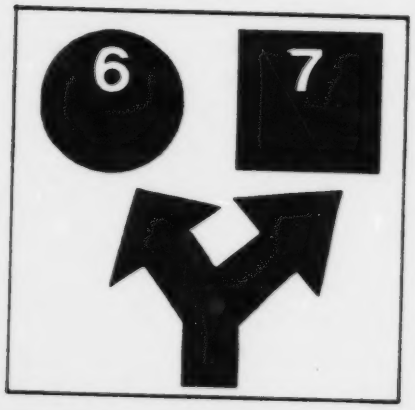
Directional and Degree of Difficulty

Directional: Good directional signage is of paramount importance in achieving user satisfaction and safety. At every location where a skier must make a decision as to which trail to select, a clear directional sign is required. Such signs can combine symbols, degree of difficulty, wording and/or numbers and directional arrows.

Degree of Difficulty

Reassurance Trail Markers

Directional Trail Signs



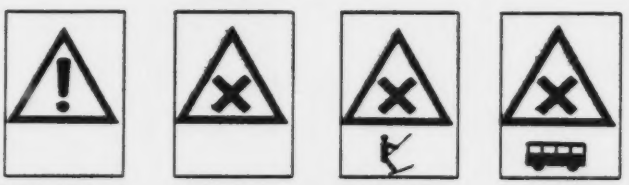
It is very important to identify clearly the degree of difficulty of individual runs on all signs. In North America the hierarchy is supported by a color code and reinforced by shape. These signs differ from Europe in shape and color (where blue is easiest and red more difficult) and in this one aspect CWSAA agrees that the North American system remain unchanged.

It should be noted that trail names have a corresponding numerical identity. This enables the number to be used in combination with the degree of difficulty symbol to reassure skiers at confusing crossing points along the trail, or where several changes of direction occur. This reassures skiers they are still skiing on the trail of their choice and ability. For this purpose a white numeral would appear on the appropriately colored symbol.

"Fireball" Bad-light Globes

In ski areas commonly susceptible to "whiteout" conditions (e.g., above tree-line skiing), it is a major advantage to have a special globe marker to guide the descent in a safe and sure manner. The Europeans have devised a bad-light globe marker which has a fluorescent green side (safe) and a red side (danger). These "fireballs" are erected on 3m (9 ft) poles and aligned so that a skier can be contained between two rows of globes and guided by the green inner side. Similar signs can be used to denote a hazard such as a cliff or a man-made feature.

Warning Pictograms



Warning: All signs warning of hazards will conform to the internationally-accepted standard: a black symbol within a black triangle (caution shape) on a yellow background. (This color coding combination is already accepted and used in the roadways of Canada and Europe.) The hazard may or may not require a written explanation as well.

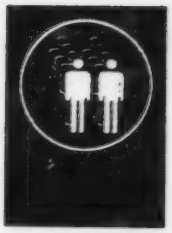
For most purposes standard dimensions will be adequate. However, in extreme or temporary situations it may be desirable to reproduce the symbol in a larger format, such as an easy or banner fence.

Regulatory Pictograms

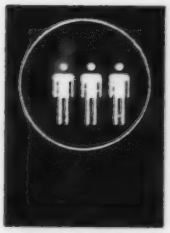
Regulatory: Similarly to warning signs, there is an accepted format for regulatory signage: a black symbol on a white background, overlaid with a red circle and diagonal line or with the prohibited activity appearing in red.

Instructional: Probably the greatest advance in modern ski area signage encountered in Europe is the replacement of wordy, unattractive instructional signs with schematic illustrations or pictograms. Although perhaps obscure in isolation, these signs when placed in the correctly related location (i.e., on respective lift tower, maze, etc.), result in better user comprehension and, therefore, a safer, smoother ski operation. Some pictorial signs should be accompanied by wording in English and in the light of international tourism, perhaps an additional foreign language. Ideally, all such wording should be standardized. The potential for messages to be converted into this format has not been exhausted. The recommended size of each sign is 50 cm x 70 cm.

Riding Chair Lifts



Doubles Only



Triples Only

Singles
Wait Here

Close Restraining
Device

Lower Restraining
Device

Keep Ski
Tips Up

Open Restraining
Device

Raise Restraining
Device

Prepare to
Unload in 10m

Clear Unloading
Area Immediately

Riding T-Bars

Self-loading T-Bar

Doubles Only

Clear Track Immediately

Prepare to Unload in 10m.

Release T-Bar

Clear Unloading Area Immediately

Recommendations

The CWSAA Sign Committee strongly believes the present multitude of signs displayed throughout ski areas in Western Canada and the remainder of North America is inadequate for the eighties and should be replaced by standardized signs based predominantly on the European system. The Committee is convinced that such a standardized system embodied in a detailed sign manual will greatly improve the professional image of Western Canadian ski resorts. Furthermore, in taking this course of action, CWSAA believes they will be making a valuable contribution to the improvement of safety levels in recreational alpine skiing, thus creating a better and more satisfying skiing experience for the customer.

Sunshine Village, Banff, Alberta, is in the process of changing all their signs for the standardized system outlined in this report. Panorama boards can be seen at 10 ski areas in Western Canada and 11 in the eastern United States.

Reprinted with permission from "Ski Area Management"

3.07 Lighting

One means of increasing use of a ski area during the winter season is to provide night skiing.

Metal-Halide lamps are fast replacing mercury units as the preferred lighting medium. Skiers object to colour loss under sodium lamps.

Table 18 shows a typical assessment for lighting fixtures.

TABLE 18
Typical Estimate for Lighting Fixtures

SKI SLOPES - varying in width from 150 feet to 400 feet require 1 FC illumination.
Length = 1 mile or 5280 ft. Width = 300 ft. Area = 1,584,000 sq. ft.
Illumination Level = 1 FC Mounting Height = 40 ft.

	POWER SPOT "MARK III"		POWER FLOOD 'P 1000 C'	
LAMP	Quantity	Staggered Spacing	Quantity	Staggered Spacing
Mercury H1000DX36-15	81 (OGB3-1006ME)	65 ft.	120 (P'Curve 4265)	44 ft.
Multi-Vapour MV1000/U	44 (OGB3-1005MH)	120 ft.	66 (P'Curve 4513)	80 ft.
Lucalox LU1000/BU/BD	35 (OGB3-1005LU)	150 ft.	43 (P'Curve 5335)	123 ft.

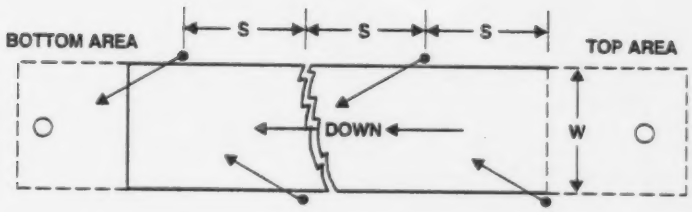
SOURCE: Canadian General Electric.

Companies such as Canadian General Electric and various consulting engineers can undertake computer analysis of present and proposed systems and prepare site specific pole spacing and lighting plans together with capital and potential operating costs.

Table 19 indicates a typical lighting layout calculation.

TABLE 19

Typical Lighting Layout Calculation

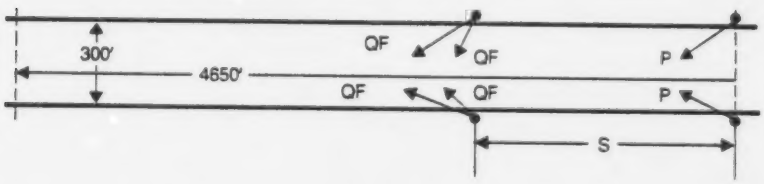


POLE LOCATIONS

Slope Width W (feet)	Recommended Spacing (S) between floodlights or banks of floodlights mounted at 40 feet above ground in trees or on poles		
	2 FLOODS/POLE 1500 Watt General Service or Quartz-Iodine Lamps		1 FLOOD/POLE 1000 Watt Mercury Lamps
Up to 150 feet	500 HOURS	100 HRS.	100 feet staggered
200 feet	150 feet staggered	200 staggered	75 feet staggered
	120 feet staggered	160 staggered	
250 feet	90 feet staggered	120 staggered	60 feet staggered
300 feet	150 feet opposite	100 staggered	100 feet opposite
400 feet	120 feet opposite	160 opposite	75 feet opposite

Example:

A ski slope has the following dimensions:



1. Total area in acres $\frac{4650 \times 300}{43{,}560} = 32$

   NOTE: 1 ACRE = 43,560 sq. ft.

2. Approximate No. of floods/acre for QF-1500A's & P-1000A's:

100 hrs/yr	500 hrs/yr	
QF-1500A	QF-1500A	P-1000A
4.5	6.1	3.35

3. For total No. of floods multiply above factor by 32 acres. Totals:

100 hrs/yr	500 hrs/yr	
QF-1500A	QF-1500A	P-1000A
144 floods	195 floods	107 Floods
KW load/flood 1.74*	1.5	1.09
Total KW-250.2	292.5	116.6

*Note for 100 hour operation filament lamps operated at 10% above rated voltage to yield 35% additional light output, but lamp life is reduced to 30% of rated value (to 600 hours for quartz-iodine lamps.)

4. Pole spacing using 40 ft. mtg. ht.

	100 hrs	500 hrs	
	QF-1500A (2/pole)	QF-1500 (2/pole)	P-1000A (1/pole)
Spacing "S"	100 ft. staggered	150 ft. opposite	100 ft. opposite

Install one Type A-4000 Powerglow at top of slope and floodlights down each side in accordance with the recommendations tabulated below.

SOURCE: Canadian General Electric.

3.08 Landscaping and Revegetation

Plant material can, and should be selectively utilized for many specific purposes and functions. With respect to ski area developments, plant materials serve other functions apart from ornamental and aesthetic effects. These include:

a) Snow Retention and Control

- Problems of snow retention on the crest of cleared runs, on the convex and on the overly exposed portions of runs, can be resolved by planting trees and shrubs (carrigana, lilac or shrub) that grow in dense formations.
- Proper planting is dependent on prevailing wind directions, slope, aspect, and other site characteristics.
- A qualified horticulturalist or agricultural specialist (District Agriculturalist, Department of Agriculture), should be able to provide information and assistance in selection, planting and maintenance of hedges, and tree cover for snow control and retention.

b) Erosion Prevention

- Erosion problems following slope clearing and grading, can be minimized by seeding base areas, runs and lift corridors as soon as possible after initial site clearing and earthwork is completed.
- To resolve gully erosion beneath rope tow and T-bar traverse lines, coarse sand should be compacted into the concave base sector of the traverse line, followed by the application of suitable grass seed mixtures.
- Natural or introduced tree cover can be used to separate runs from:
  - other runs
  - lift lines
  - non-skiing base users
- Plant material in this case improves safety and aesthetic features.
- Plant materials are most effective for:
  - masking out objectionable views
  - creating an identity for each run (visual)
  - screening base area facilities and structures from runs
- Unique and special features of each site should be evaluated prior to any formal landscape design or planting plan. Factors such as soils, soil mixture, aspect (exposure to sun), plant hardiness zones, and potential erosion problems should be considered. The "Alberta Horticultural Guide", available free of charge from any Department of Agriculture office, contains useful information on plant materials and their special limitations and requirements. Planting of those species native to an area is recommended, although new species can be introduced to add variety to the natural foliage.

Table 20, offers recommendations with respect to seed mixtures for ski slopes however, this selection of seed mixtures should be based on a comprehensive site analysis of soils, drainage, runoff patterns and vegetation.

TABLE 20

Sample Seed Mixtures for Ski Slope Grasses

	NORTH ASPECT (SHADY)	SOUTH ASPECT (SUNNY)
20% + Slope	30% Alfalfa 30% Creeping Red Fescue 20% White Clover 20% Russian Wild Rye	40% Alfalfa 20% Creeping Red Fescue 20% Russian Wild Rye 20% Crested Wheat Grass
5%-20% Slope	30% Alfalfa 25% Creeping Red Fescue 25% White Clover 20% Annual Bluegrass	30% Alfalfa 25% Creeping Red Fescue 20% Crested Wheat Grass 25% Annual Bluegrass
0%-5% Slope	40% Creeping Red Fescue 30% Common Kentucky Bluegrass 30% Rough Stalked Bluegrass	

NOTE:

1. Where annual precipitation is less than 20 inches large proportions of Crested Wheat Grass and Russian Wild Rye Grass should be applied.
2. Reduce the proportion of Kentucky Blue Grass in shaded areas.
3. Rates of application to be approximately 4-5 lbs per 1,000 square feet.
4. Above percentages are by weight measure.
5. Suitable fertilizers should be applied.
6. Best seeding time is in June.
7. The above are only guidelines. Recommended mixtures may vary with soil and local climate.

SOURCE: 1976 Edition "Ski Area Planning".

For further information on landscaping and revegetation consult, "National Forest Landscape Management Ski Areas, Volume 2, Chapter 7". (USFS).

3.09 Base Facilities and Services

The base area is where the majority of services are offered. It has the most intensive use plus a higher concentration of people then the slopes or other outdoor use areas. A base area should be designed to compliment the skiing terrain. For example modest base area facilities are best suited for a small community ski hill. The larger and more extensive the ski slopes and lifts are, the larger the variety of service facilities.

Actual design and layout plans for the base area are the responsibility of architects and planners. They will determine the necessary service and support facilities needed and plan accordingly.

The location of the base area on a particular site is determined by a number of factors:

- accessibly from the entrance road, lifts or tows and other activity areas
- available land area grading requirements
- aesthetic qualities of the location (view of the hill)
- climatic conditions (shelter from wind and snow drifting and solar orientation)
- availability of utility services (water, electricity, heating and communication)
- land ownership

The base facilities at a ski area are the focus of recreational activity. The function, character, convenience and aesthetics of the base facilities all contribute to the skier experience. If the base area is a well planned and functional group of facilities and activities, it could add greatly to the desirability of the ski area as a whole and increase the likelihood of return visits and growing market demand. Ski areas require careful layout to effectively move visitors from their vehicles onto the ski slopes. The focal point is in and around the day lodge and functions must be carefully arranged both horizontally and vertically to maximize visitor enjoyment and area revenues while minimizing traffic congestion, visitor confusion and area management problems. The five functional zones identified are:

- entry/arrival
- primary services (tickets, restrooms, information)
- secondary services (retail, ski rental and repair, ski school, nursery, public lockers and change areas, food and beverage services)
- skier congregation (ski racks, posted information, sun decks, lift mazing areas)
- operational/service functions (area administration, staff lockers, storage and mechanical, kitchen, first aid, caretaker suite)

Some factors to be considered in any base area design are:

Lodge or Shelter

The central lodge or shelter should be planned according to the expected and projected future capacity of the area. Detailed design of a lodge depends upon the financial resources available for construction and operation. A ski lodge can be very comfortable and yet be of modest design or it can be a very elaborate complex.

Some planning considerations of a lodge for use by skiers are:

- flooring durable enough to withstand traffic wearing heavy, metal-plated ski boots
- special drying racks for wet or damp clothing
- open, spacious warming area

Usage can determine possible divisions for the lodge. Often one or more of the following areas have been included in existing lodges:

- foyer - heated, with boot racks, drying racks
- rest rooms - corresponding to user requirements
- lounge - open space with appropriate facilities (fireplace, benches, chairs, tables)
- ski patrol and first aid area
- ski shop - may or may not be included in a separate structure
- ticket sales booth
- administrative office
- staff quarters, instructor's rooms
- locker area - for ski storage
- cafeteria
- optional - liquor lounge, sun deck, nursery, and dance area

Restaurants and Food Areas

Ideally skier movement should be minimized between the slopes and restaurant facilities. Proper mountain planning is dependent upon dispensing skiers throughout a lift and trail pattern and consequently restaurant placement is critical. Obviously these cannot be placed adjacent to every lift, but they should be located so as to minimize transportation from all skiing terrain.

The area required per skier in food areas is based on a seat "turnover" basis or number of sittings per meal. This varies from 4 to 10, depending on the type of meal and the efficiency of the operation.

Toilet Facilities

Are usually provided at the restaurants and at the lift terminal buildings.

Medical and First Aid Facilities

Are usually provided at the base of the mountain.

Commerical Space

- ski shop, ski rentals
- service stations, stores

Support Service Buildings

- maintenance building
- garage
- lift terminals - as required for safety requirements
- snow making control and pumphouses

Overnight Lodging Facilities

- public overnight - motels, hotels or resorts
- private overnight - cabins, condominiums

NOTE: All structures must conform to the National and Provincial Building codes, as well as any local building codes for a particular municipality.

For further information on the design and construction of facilities, consult:

- "National Forest Landscape Management Ski Areas, Volume 2, Chapter 7"
- "Mt. Allan Ski Area Master Plan"
- "Ski Facilities: A Bibliography"

Roads

Entrance:

- should be obvious, well marked
- clear directional signs on access
- safe deceleration and acceleration lanes off major access road
- wide access for snow plowing
- gentle grade entrance, both ways
- entrance road should lead directly to parking area
- allow for parking, bus loading and unloading areas
- minimum turning radius for buses on two-way system 24 to 30 m (80 to 100 feet) and on a one way system 15 m (50 feet)
- all turn-offs at 90 degrees or less
- maximum grade of 10% or as required by each municipality
- width - minimum 5.5 m (18 feet) to a desirable 6-7.5 m (20-25 feet) width and crowned to standard road specifications

- road should lead directly to parking or loading area without passing through user areas
- determine initial construction costs of all roads at cost per meter, and establish who is responsible for construction
- determine maintenance costs (including snow plowing) and formulate policies and agreements for maintenance responsibility for all roads

Internal roads on the ski area should be located so that they do not interfere with ski runs and be located and designed to take due account of the erosion resistance capabilities of the soils. The construction of access roads for tower erection must be carefully considered. Generally they are not permitted because of the following considerations:

- Soil erosion or water pollution problems
- Creating a hazard for skiers
- Creating visual scars on the mountain

Parking Requirements

The area required for parking will depend on the number of skiers that travel by private car. This in turn depends on the provision made for on site accommodation or the provision of public transport or private bus shuttle.

The figure used for design purposes varies from 2.8 to 3.1 skiers per car.

The flatter slopes from 0%-10% are usually used for parking. Parking areas have to be drained and surfaced for all weather use.

Parking area:

- well-signed for directional traffic flow or attendants
- allow a minimum of 1 1/2% slope for drainage
- landscape fringe areas of the parking area for better aesthetics
- provide separate area for bus loading and unloading areas

3.10 Environmental Protection Guidelines

If the following guidelines are implemented in conjunction with measures to revegetate disturbed areas following construction, as described in the master plan, erosion, sedimentation and deterioration of water quality should be minimized:*

- Belts of undisturbed vegetation should be maintained wherever possible along drainage channels to prevent stream bank disturbance and sediment input into streams. Timber removed should be felled away from the stream channel to minimize damage. The buffer or filter belt of undisturbed vegetation will slow runoff, facilitate infiltration and filter out sediments. The width of the buffer will depend upon precipitation, vegetation, soils and slope steepness. A general rule is that buffer width should be 7.5 m for flat terrain and the width should increase 0.6 m for every 1 percent increase in slope steepness.

- The key aspect of surface water control which must be emphasized is that runoff should not be allowed to concentrate on the ski runs. If this happens, gullying may occur and high rates of sediment production will result. To deal with runoff, cross-drains should be constructed as required to channel runoff into undisturbed areas between runs where it can spread out as sheet flow. If possible the flow should be directed towards the nearest channel so that drainage does not cross adjacent ski runs.

- Revegetation of disturbed areas should occur immediately following construction. Site specific investigations are needed to develop an effective and comprehensive revegetation program. The revegetation program should be developed in conjunction with Fish and Wildlife representative to ensure compatibility of the plan with wildlife management objectives.

- Minor increases in streamflow and sediment loads are to be anticipated as a result of development and these effects may be largely eliminated by conforming to the water management guidelines.

- Ski runs can cross streams necessitating removal of stream bank vegetation. Bank vegetation helps to filter sediment from runoff and provides a major source of nutrients to oligotrophic mountain streams; thus, stream bank clearing must be avoided to the greatest extent possible.

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* Derived from "Mt. Allan Master Plan - Summary".

CHAPTER IV

OPERATION AND MAINTENANCE

4.01 The Ski Area Manager

A ski area manager, whether paid or volunteer, must fulfill the five management functions of:*

1. Planning

   This function involves the establishment of specific administrative objectives and policy, according to the objectives and terms of reference of the project.

2. Organizing

   Included in this function is the staffing and the provision of public services.

3. Directing

   This is the directing of the day to day operation of the business.

4. Co-ordinating

   This is the co-ordination of the activities of the employees with the services to be provided.

5. Control

   This requires control or supervision of the entire development to see that it operates to meet its objectives.

Ski area management methods have matured over the past decade. Education and training programs have improved (see Section 4.03) and the magazine "Ski Area Management" serves the industry well. A review of back issues provides an excellent background to the issues and concerns of ski area management.

Two important management issues are reviewed briefly:**

Setting Prices

Establishing lift prices for the season is an important aspect of policy making at a ski resort as the rates may have a significant effect on attendance and on profit margins. Setting prices requires careful weighing of several factors, including the return on investment that is required, estimated strength of the market, and

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* From "Management of Outdoor Recreation Enterprises".

** From "Ski Resort Manual" (Ontario).

fees charged by competing resorts. It is important to forecast increases in operating costs, as brochures must be prepared long before the season begins. The establishment of different rates between the weekend and midweek, junior and adult tickets, and tickets on longer and shorter lifts also requires a sensitive understanding of the market. A pricing policy will include a wide range of alternatives to the potential user of the resort. The sale of large numbers of season passes commits a high proportion of the lift capacity, at a lower rate and may increase lift line-ups and decrease attendance of irregular visitors. On the other hand, season pass sales bring in guaranteed revenues and a healthy cash flow at the beginning of a season. Skiers are attracted by the special status of having a season pass and by the convenience of not having to line up to purchase day tickets. Discounts for groups will pay off in volume of sales, additional foods and beverage sales, and rental of skis and boots. Some areas also offer multi-day discounts to encourage skiers to stay longer.

Controlling Access to Lifts

Season pass holders are usually assigned a plastic identity card at the beginning of the season. Lift operators must be alert to match photographs with faces of the season pass holder.

Day tickets and half day tickets are sold at convenient points at the resort and are attached to the skier's clothing. The most common ticket is a gummed tag that is sealed around a wire holder that has been run through the loop of a jacket or the tab of a zipper. The tickets are numbered for identification, and a wide variety of colours and stripes is available in order to distinguish the type of ticket. Each ticket is stamped with the date for which it is valid, and colours are usually rotated from day to day to facilitate recognition.

As prices increase, cheating is becoming more rampant. Cheaters will attempt to ski as long as possible without a ticket, or more successfully, will divide their ticket in half and share it with a friend. It is important to apprehend offenders, as the habit has a tendency to spread. Some managements offer additional monetary incentives to lift operators, rewarding them for each detection of a skier without a ticket or false ticket. Prosecution and publicity of prosecution has been a definite deterrent where possible. The skiing public must be encouraged to regard getting on a lift without a ticket as equivalent to theft of merchandise. Policing tickets at a ski area requires firmness but courtesy and discretion as well. The average skier does not cheat and dislikes being suspected.

4.02 Site Operating Plan

Administrative policy for management of a ski area should be established during the planning stage before the facility is completed. Hired staff, including an on-site manager, may be required, or volunteer staff may handle operations with policy decisions themselves made by the directors or operating committee.

The typical major components of an operating plan itself are:*

(a) The purpose of the Operating Plan is to provide the justification for the proponent's decisions to acquire capital assets and to assess the economic benefits to be derived therefrom.

(b) An Operating Plan will generally consist of the following:

i) Statements and assumptions which impact the overall project.
ii) Ski operations facts and assumptions, estimated utilization, and economic considerations respecting:
- lift operations;
- day lodge; and
- ski school and shop.
iii) Townsite development facts and assumptions, estimated utilization and economic considerations respecting:
- accommodation;
- food and beverage; and
- convention facilities.
iv) Utilities development and operations.
v) General and administrative costs, including interest.
vi) Government assistance.

Some key elements of an operating plan for the ski area itself follows:**

1. Statement of Responsibilities and Procedures, including public parking and access requirements.

2. Winter Operation (Review Annually by November 1):

a) Ski patrol and first aid procedures, including location of patrol stations, sweep procedures, lift evacuation, avalanche control and rescue, accident reporting, communications, etc.
b) Lift operation and procedures.

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* From "Commerical Alpine Skiing Policy, Section 3.4.0200".

** From "Systems Approach to Winter Sports Site Administration", (USFS).

c) Trail maintenance and grooming, including sno-cat operations, snow making, etc.
d) Customer service operations, including hosts, etc.
e) Ski school procedures.
f) Signing.
g) Building.
h) General safety and sanitation.
i) Communications.
j) Public Transportation.

3. Summer Operation (Approved Annually by April 15):

a) Area fire protection.
b) Erosion control.
c) Tree and debris disposal.
d) Sanitation.
e) General safety (including public safety).
f) List of planned development work for the work season.
g) Design criteria and landscape.
h) Road closure program.
i) Vegetative management.

Table 21 illustrates a detailed winter and summer operating plan checklist.

TABLE 21

Detailed Winter and Summer Operating Plan

Preface/Introduction

- Authorized Representatives
- Scope of Operations
  a. Operating Season
  b. Season Operating Level or Capacity
- Operations Area
  a. In Bounds
  b. Out of Bounds
  c. Specific Restrictions
- Facilities
  a. Lifts and Trails
  b. Parking
  c. Ticket Plazas
  d. Restaurants (Base and Mountain)
  e. Restroom Facilities
  f. Repair
  g. Rental
  h. First Aid Facilities
  i. Patrol Headquarters
  j. Warming Rooms
  k. Explosive Caches
  l. Mechanical and Equipment Storage
- Responsibilities
- Safety
- Inspections
- Monitoring Procedures
- Required Documents
- Frequency Schedule
- Reports and Records Summary
- Summer Programs and Activities
- Host Activities
- Nature Study and Tours
- Summer Slides
- Foot Trails
- Horse Trails

WINTER OPERATING PLAN

Ski Patrol

- Scope of Operations
  a. First Aid
  b. Avalanche and Forecasting
  c. Closures
  d. Emergency Measures
  e. Host
  f. Training
  g. Racing Events

- Organization Chart
- Staffing
  a. Duties
  b. Job Descriptions
- Qualification Requirements
  a. Advanced First Aid or E.M.T. (Preferred)
  b. Current C.P.R. Card
  c. Expert Skier
- Communications
  a. On the Mountain
  b. Emergency Telephones
  c. Portable Radios
- Sign Plan
  a. Trail
  b. Boundary
  c. Information
  d. Directional
- Patrol Equipment
  a. Patrol Headquarters
  b. Warming Areas
  c. First Aid Equipment
  d. Avalanche Rescue Equipment
- First Aid Procedures
  a. Team Procedures
  b. Numbers on Duty
  c. Time Elements
  d. First aid Refusal
  e. Dispatching
     1) Receiving Calls
     2) Accident Investigation
     3) Dispatching Team
  f. In-Area Search and Rescue
     1) In Bounds
     2) Out of Bounds
  g. Transportation
  h. Accident Reports
  i. Accident Notification
  j. Ambulance Procedures
  k. Equipment Return
  l. Mountain Medical Facilities
- Sweep Procedures
  a. Describe by Trail and Lift
- Night Time and Out-of-Area Search and Rescue
- Avalanche Hazard Measures
  a. Training
  b. Avalanche Forecasting and Control Measures
  c. Call-Out Procedures
  d. Avalanche Control Routes
  e. Explosives
  f. Ski Cutting
  g. Avalanche Rescue
- Lift Evacuation Procedures
  a. Toboggan Evacuation
  b. Passenger Evacuation
- Major Emergency Plan

- Ski Racing
- Host/Hostess/Guest Relations
- Dress
- Incident Reports (Non-medical)
- Lost and Found
- Trail Opening and Closing
- Snowmobile Operations
- Jumps and Controls
- Control of Non-skiing Devices
- Violation Controls
- Crowd Controls
  a. Lift Lines
  b. Line Cutting
  c. Special Events
  d. Rowdiness, Drinking, Drugs, Etc.

Lift Operations

- Scope of Operations
- Facilities
- Organization Chart
- Staffing
  a. Training
  b. Qualifications
  c. Job Descriptions
- Lift Operation Procedures
  a. Safety First
  b. Any Safety Acts
  c. Customer Relations
  d. Employee Breaks
  e. Schedules
  f. Communications
     1) Telephones
     2) Intercoms
     3) Radios
- Emergency Procedures
  a. Derailment or Deropement
  b. Fire
  c. Rollback
  d. Lift Doesn't Stop
  e. Other Emergency Situations
- Auxiliary Procedures
- Accident and Incident Reports
  a. Skiing Accidents
  b. Lift-Related Accidents
  c. Incident Reports
  d. Employee Accidents
- Extreme Weather Conditions
  a. Wind Procedures
  b. Lightning Procedures
  c Extreme Cold
  d. Extreme Snow and Ice
- Lift Evacuation Procedures
  a. Responsibility
  b. Chair Lift Evacuation

c. Gondolas Evacuation
d. Evacuation Alert
e. Backup
f. Equipment and Location
g. Training Procedures

- Mountain Policies Concerning Lift Operations
  a. Lift Line Cutting Policy
  b. Ticket Control
  c. Foot Passengers
  d. Hand Carried Items
  e. Racing Slalom Poles
  f. Evacuation Toboggan Procedures
  g. Loose Clothing
  h. Pets
  i. Signing for Egress
- Lift Maintenance
  a. Sources
  b. Lift Dispatcher
  c. Scheduled Maintenance
     1) Weekly Inspection
     2) 500-Hour Inspection
     3) Other Mechanical Maintenance
     4) Electrical Maintenance
  d. Unscheduled Maintenance
- Lift Construction
- Ticket Checking
  a. Season Passes
  b. Club Cards
  c. Daily Tickets
  d. Multi-Day Tickets
  e. Touring
  f. Beginner
- Downhill Loading

<u>Mountain Procedures</u>

- Scope of Operations
- Organization Chart
- Slope and Trail Maintenance Crews
  a. Scope of Operations
  b. Staffing
  c. Qualification Requirements
  d. Schedules
  e. Slope Grooming Procedures
  f. Safety
  g. Packing/Grooming Priorities
  h. Over-the Snow Transportation
  i. Transportation Routes
  j. Equipment Logs
  k. Work Logs
  l. Punctuality and Absence from Duty
- Snowmobiles
  a. Scope of Operations
  b. Operator Qualification Requirements
  c. Snowmobile Operating Procedures

  d. Safety
  e. Snowmobile Routes
- Vehicle Maintenance
- Snow Making

Ski School

- Scope of Operations
  a. Area Operated
  b. Contracted Operated
- Organization Chart
- Ski Instruction
  a. Staffing Levels
  b. Qualification Requirements
  c. Training and Aids
  d. Type Lessons Offered (Teaching Procedures)
  e. Class Sessions
  f. Attitude
- Children's Programs
- Handicapped Programs
  a. Authorized Equipment
  b. Special Assistance
- Control of Unauthorized Ski Instruction
- Glossary of Skiing Terms

Special Services

- Parking
- Transportation
- Road Maintenance
- Base Facilities
  a. Ingress and Egress
  b. Fire Protection
  c. Ice and Snow Removal
  d. Sanitation
- Service Center
- Base Restaurant
- Maintenance Yard and Equipment Storage
- Patrol Headquarters and Warming Facility
- On-Mountain Photography Concession
- Special Events
- Company Property
- Company Vehicles
- Incident/Complaint Reports
- Job Descriptions
  a. Locker Attendants
  b. Parking Lot Attendants
  c. Ski Check Attendants
  d. Ski Storage Attendants
- Locker Rooms (Employee)
- Lost and Found
- Punctuality and Absence
- Schedules
- Towing Vehicles
- Uniforms
- Communications Sites and Antennas

Sign Plan

- Trail
- Base
- Parking
- Designated Egress (Boundary)
- National Forest Identification
- Signing Restrictions

Area Employee Handbook

- Host Responsibilities
- Policies and Procedures
  a. Equal Employment Opportunity
  b. Employee Definitions
  c. Administrative Offices
  d. Attendance and Punctuality
  e. Probationary Period
  f. Seasonal Employment
  g. Other Employment
  h. Employment of Relatives and Friends
  i. Parking
  j. Lift Opening and Closing Time
  k. Lift Line Privileges
  l. Pets on Company Property
  m. Payday/Time Cards
  n. Payroll Deductions
  o. Jury Duty
  p. Vehicle Use
  q. Name Tags
  r. Telephones
  s. Safety Policy
  t. Funeral Leave
  u. Leave of Absence
- What We Expect From You
  a. Friendliness
  b. Operation/Evaluation
  c. How We Look and Act
  d. Uniforms
  e. Lost and Found
  f. Company Property and Equipment
  g. Hunting Within Ski Area Boundaries
  h. Suggestions/Complaints
  i. General Policies
- What You Can Expect From Us
  a. Season Ski Pass
  b. Complimentary Day Pass Policy
  c. Employee Area Operator Cards
  d. Group Insurance
     1) Hourly
     2) Salaried
  e. Sick Leave
  f. Holiday Pay
  g. Vacation
  h. Bonus
  i. Workmen's Compensation

Master Avalanche Control Plan

- General Overview of Permit Area
  a. Transportation
  b. Avalanche Area Identification
  c. Avalanche Map
- Avalanche Control Equipment
  a. List by Type and Location
  b. Location Map
- Team Members
  a. Names
  b. Telephone Numbers
  c. Training Qualifications
- Avalanche Rescue
  a. Introduction
  b. Incident Reporting Procedures
  c. General Alarm
  d. Rescue Zones
  e. Rescue Procedures by Zones

Special Skiing Devices and Programs

- Skibobs
- Handicapped Skiing
- Cross-Country Skiing - On-Site and Off-Site Touring
- Helicopter Skiing - On-Site and Off-Site

Authorized Non-Skiing Devices

- Sleds
- Toboggans
- Snow Surf Boards
- Snowmobiles

Special Events

- Races
- Winter Carnivals

SUMMER OPERATING PLAN

Delegation of Authority

Lift Operations

- Visitor Tours
- Slide Access

Summer Work Projects

- New Construction
- Reconstruction/Improvement (On-Going Projects)
- Controls on New Construction Around Summer Visitor Programs

Safety Patrol

- Signs
- Communications
- Medical Facilities

Buildings and Concessions

- Summer Slide
- Jeep Rides
- Restaurants
- Trails, Etc.

Fire Plan

NOTE: Derived from a "Systems Approach to Winter Sports Site Administration" (USFS).

Revenue Considerations

If a ski area is club or municipally owned, it should endeavour to be self-sufficient. The development should at least generate enough revenue to cover costs. Five variables affecting ski area profitability include:*

1. Ski Area Capacity

- This is the capacity of skiers and/or people that can be endured on one particular site.
- Profitability is affected by how well utilized a facility is as compared to its capacity.
- A ski area must exceed 35% average capacity to reach operation break even.

2. Income Per Skier Visit

- Defined as gross income from lift ticket sales, plus income from related supporting activities of ski school, equipment rental, food service, ski shop, etc.

3. Cash Operating Cost/Capacity

- Cash operating costs are all costs except interest and depreciation.
- To evaluate operational efficiency, costs should be related to some measure of capacity.
- Daily average costs are calculated and divided by the ski area's average skier capacity.

4. Capital Cost/Capacity

- Efficiency of site, design, and construction is measured by relating total Gross Fixed Assets (G.F.A.) to skier capacity.
- Calculated by dividing G.F.A. by the skier capacity.

5. Length of Season

- Equipment and facilities depreciate over time and the more utlized an area is during the year, the more profitable it will be.
- The longer a season, the more utilized an area is.

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* From article "Break-Even Characteristics".

4.03 Education and Training

The following article, in relation to education and training, appeared in the magazine "Ski Area Management".

Managing

by Chris Stoddard
President, Mountain Management Services

TO KNOW IS TO TRAIN

Employee training at ski areas is in considerable upheaval. The old ways of on-the-job training are being replaced with coordinated programs developed by in-house training managers or by the use of off-the-shelf programs developed by training specialists. This new emphasis comes at a time when skiers are demanding more professional services from ski areas and area employees, and as ski area managers are seeking new ways to meet the demands of both the skiers and the competition.

Although employee training is not a cure-all, it has many positive benefits which affect skiers' experiences and, ultimately the financial picture of ski areas. Some benefits of a well managed training program can be:

- skills training helps seasonal staff learn new jobs correctly,
- skills training sets standards for performance,
- training programs can set standards for professionalism on the job,
- training builds loyalty and identification with the ski area,
- training is documentable - it can be a good court defence.

What makes a good ski area employee training program? Is it welcoming speeches by the general manager? Films or employee guides? Demonstrations? On-the-job training? Role playing or practice assignments?

Any of these techniques can be used in training, but by themselves they can't do the job. Communicating new ideas in ways people not only understand, but can also apply, takes planning and effort. Some experts say that in order to get an idea across to people who are not familiar with a subject, the leader needs to teach it three times, in three different ways. Usually this means lecture, film or demonstration and then practice. This can work for some people, but often it lacks the magic ingredient of interest and excitement which captures attention and generates involvement.

Remember, the audience - usually new, seasonal employees - knows little about running a ski area, even if they are skiers. They don't know the terms or jargon and they don't identify with the organization. They don't know what needs to be done or why it should be done at all.

JOB SKILLS TRAINING

Ski resorts and ski areas usually use training to teach job skills rather than to develop management skills. In this type of training you are trying to give the new, seasonal employees enough information about their jobs so they can perform them correctly. Job skills are the basis for

pre-season training and include tasks such as lift attendant or operator, snowmaker, cashiering, ticket selling and other basic work. Often you get only a single chance to explain a job to a new employee and then it's time to open the doors, start working and start skiing. In this case you can hope that the new employee was interested enough to pick up the knowledge needed to do things correctly.

Frequently ski area supervisors rely on on-the-job training as a major component of job skills training programs. Recent research has indicated that on-the-job training is often far less cost effective than formal training programs and also is less efficient in teaching job skills and setting work standards. Traditionally, employers have used experienced returning employees to "break in" the new staff members, forgetting that 'old hands' may have bad habits and new employees will learn how the 'old hands' remember the job - not necessarily how it should be done.

Despite these problems there are ways to achieve good job skills training with a moderate amount of time and preparation. For example, when using on-the-job training the supervisor should first spend time with the new employees. He or she should show them around, tell them about the department, explain standards and set some expectations. Then a formal training program can start. It may be conducted by the supervisor or by specially training 'old hands' who can teach the responsibilities and tasks as they should be performed. Call these people "training assistants" or "leader workers" or some similar title and make training a regular, if infrequent, part of their job assignments. You can use these people throughout the season to train replacement employees as they are brought into the department.

If the ski area has a policy manual or handbook, be sure the new staffers read it. Next, look for other training tools available. Is there a job instruction manual? A check list of training topics? Are there other teaching aids which can shorten the time required to get the ideas across and to provide another format for learning other than lecturing? Use them if you have them, but if you don't have any, you can build them. They make the job of training easier and they help get the trainees up to a fully functioning level of job skills much more quickly.

Once the formal job skills training program has been conducted, on-the-job training can be used. But, instead of assigning new staffers to work with the best 'old hands', use returning employees with good verbal skills and relatively good levels of job performance and to help the new staffers get started. Once the new staffers have gotten an introduction to the job routines you can pair them one on one with the best 'old hands'. This way you can take advantage of your best employees skills by having them help get the dpeartment ready to open for the season, while those who are good together are helping new employees learn the routines.

CUSTOMER RELATIONS TRAINING

Performing the assigned job tasks is only one part of a ski area employee's responsibilities. Customer relations is another very important job for every employee who meets guests. Of course supervisors

want employees to "be nice to the guests", but it isn't enough to simply tell them that. Most job frustrations are caused by guests and most of the customer's unhappy experiences are caused by employees who are unable to deal reasonably with problems.

Employees need to know the ski area's organization and where to get appropriate help. Spend plenty of training time describing all area services, locations and hours. Explain how to get help for a guest and go over procedures for handling routine problems such as lift grease on clothing, missing ski partner, lost tickets, etc. Make sure that employees know where to turn for help and how to direct skiers there or how to summon help quickly if needed. The attitude of helpfulness and high regard for guests must come from the top of the organization and be felt by everyone. Employees sense the attitudes of management and respond in kind.

For some reason, many people feel uneasy playing host or hostess to guests, or they simply don't know how to do it. Practice helps them get over such uneasiness and builds confidence. Try a few role-playing situations in which each employee actually helps another person out of a make-believe difficulty. This will increase confidence, so the employees can repeat the performance in real life. A word of caution: don't let things get out of hand. Keep the tone friendly, but serious, just as it would be on the job.

TRAINING AIDS

How does a supervisor start using training as a tool to develop a stronger, more qualified staff? Perhaps the best way to start is by trying one or more of the programs or aids available from training specialists or from NSAA. If you purchase training aids which you think may meet your needs, take time to carefully evaluate them. A program should help you get started, but one that you have a particular interest in or sense a great need for is probably best for starters. If the material comes with a leader's guide, go through it completely. It should give you some idea about how the training specialist views the subject and how he has tried to meet objectives. The leader's guide should also give you tips on how to use the materials most effectively.

Once you have reviewed the leader's guide, take a look at the other training materials, such as an audio-visual program or written materials and plan how you can use them to get your own message across. Because you have your own procedures and needs, it is important that you have a chance to explain them, not just rely on the program to do it all. Training materials are just aids to help you get your own ideas across and to shorten the training time. Modifying a training program or aid can be somewhat like building a whole new program, except that some of the hardest work has already been done for you.

Once the challenge of using an existing training program has been met, you may want to expand on it or work on one of your own. Start this task by doing a complete analysis of the OACR: Objectives, Audience, Content (including tasks) and available Resources. Supervisors and lead staff

members should put these things down on paper so that anyone can understand them. They form the plan basis and help formulate a training schedule, activities and format.

Objectives - What are your objectives? Why do you want to hold the training courses? What results do you expect? Use concrete examples of behaviours or skills you want to develop. An example would be to have a ticket seller able to sell all types of single and multi-day tickets and to be able to accept cash, make change and record credit card transactions to be able to do the job when they have finished their training. (You might also add how well you want them to be able to do the job.)

Audience - Who will the audience be? Who are these new employees? Are there returning employees to be trained? At the same sessions? What motivates them to do a good job? How much do they already know about this work? Developing a trainiry program must take these factors into account.

Content - What do you need to teach to meet your objectives? A good way to look at this is to begin thinking about the job to be done, as the employee would look at it while doing it. Start with the first areas of responsibility. Write them down. Go through the whole day like this. Go back to each of the areas of responsibility and flesh them out with the specific tasks which go into its makeup. Now you have an outline for a training plan with the areas of responsibility as your headings and the tasks as your training topics.

Resources - Available resources are the people, places and aids available to you when you conduct the training. They dictate to a great degree how you will actually do the training and what format you will use to teach each training topic. Remember to vary the program as much as you can because people tire easily. Use all the sources you can: outside speakers (a snow ranger or insurance representative, for example) film or audio-visual programs, classroom setting alternating with job-site training, etc. Can you offer refreshments during your breaks? Is the setting a spot where people can learn, or are there distractions?

Bringing all this together into a program that is presented to new employees and returning 'old hands' takes a lot of planning and preparation. But the results are worth the effort because guests respond very well to employee professionalism. Off-the-shelf programs can make the job of training employees both easier and smoother, because all you have to do is adapt them to your own needs rather than begin at the beginning.

In addition to these programs, there are programs from other industries that can be adapted for ski areas. The food and beverage industry and the lodging industry, for example, have programs which can be applied to ski area needs. In addition, there are technical training programs in welding and other technical subjects which can be used. Reviewing needs and available resources will help you match your training needs with your ski area's desires for growth and success.

Reprinted with permission from "Ski Area Management".

Alberta Recreation and Parks through the Outdoor Recreation and Sport Facilities Section holds workshops for regional ski area managers. In addition, the following have education and training programs:

CWSAA:

Seminars on subjects such as:
- Risk Mangement
- Safety Administration and Evaluation
- Food and Beverage Management
- Snow Making
- Snow Grooming
- Lift Evacuation

Selkirk College (Nelson, British Columbia):

Selkirk College's Ski Resort Operation and Management (SROAM) Program trains men and women for a wide range of positions in the ski industry. All students receive instruction in lift operations, snow grooming, snow making, marketing, public relations, ski area planning, management skills, service and operations management. Students select a specialty in either inside or outside operations. Inside operations include additional studies in marketing and public relations, ski rental/retail management, accommodation and food and beverage management. Students choosing the outside operations specialty take instruction in welding, electricity, mechanics and preventive maintenance.

The program is divided into trimesters. The fall semester provides an excellent introduction and orientation to the industry and its unique features. The winter term is a paid practicum at a ski resort in western Canada. For the spring session, students return to Selkirk College for instruction in their specific area of interest.

FALL SEMESTER:

Core Courses

SROAM 154	Ski Area Management
SROAM 152	Ski Area Planning I
SROAM 150	Introduction to Marketing and Public Relations
SROAM 182	Lift Operation and Maintenance I
SROAM 160	Financial Management
SROAM 181	Slope Grooming I
SROAM 158	Risk Prevention and Management
SROAM 156	Personnel Management and Supervisory Skills I
SROAM 180	Snow Making

Field Trips

Ski Show: 4-5 days
Snow Making/Accommodation: 2-3 days

Option Electives

Inside Operations:	SROAM 166	Accommodation Management
Outside Operations:	SROAM 162	General Electricity

WINTER WORK SEMESTER:

1. Each student works as a paid, full-time employee at a ski resort.
2. Each student will attempt to secure a job rotation schedule that places the student in various operations at the resort to give the student the widest possible range of experience during the work practicum semester.
3. Work practicum evaluation will be the responsibility of the College and the employer.

SPRING SEMESTER:

Core Courses

SROAM 181	Slope Grooming II
SROAM 184	Avalanche Hazard and Ski Patrol
SROAM 182	Lift Operating and Maintenance II
SROAM 152	Ski Area Planning II
SROAM 156	Personnel Management and Supervisory Skills II & III

Field Trips

Ski Areas Field Trip: 5-6 days
CWSAA Annual General Meeting: 5-6 days

Option Electives

Inside Operations:

SROAM 164	Food and Beverage Management
SROAM 168	Ski Retail/Rental Shop Management
SROAM 170	Ski School Management
SROAM 151	Ski Area Marketing and Public Relations

Outside Operations:

SROAM 184	Lift Maintenance
SROAM 174	General Welding
SROAM 176	General Mechanics and Preventive Maintenance

The minimum educational requirement is grade 12 or the equivalent. Preference is given to applicants with significant ski industry work experience. A recommendation from the ski area manager or appropriate supervisor is required. Applicants with specialized trade training or a post-secondary degree wishing to apply their training or education to a career in the ski industry will be considered.

Applicants must demonstrate a sincere interest in a ski industry career and a willingness to work at any starting position.

All applicants are required to attend a personal interview with the instructor before their application is considered for admission to the program.

Students wishing to apply for admission should fill out an application form (available at Student Services) and send the form to Selkirk College, 2001 Silver King Road, Nelson, B.C., V1L 1C8.

Peter Wood, B.A. (Hamilton College) instructor and co-ordinator. NOTE: The program makes extensive use of specialists from the ski industry and other areas of Selkirk College to teach specific parts of the program.

Financial assistance may be available to students who are unable to meet educational expenses. For information about sources of loans, bursaries, scholarships and application procedures, contact the College's Financial Aid Office.

The program at Selkirk College is approved by CWSAA for its member operators.

Humber College in Ontario offers the following program:

SKI AREA OPERATION

North Campus

Post Diploma Program of three Semesters (one being a field placement).

The combination of business and technical content of this program will provide the graduate or mature student with the knowledge required to operate a ski area business. Because the ski industry is still developing, openings exist for those who have the required skills and education.

Admission Requirements

Mature student with two seasons experience in at least one aspect of a ski resort or hotel;
OR
Graduate of the Recreation Leadership or the Hospitality Management program.

Job Opportunities

For mature students, this program will usually bring them a step higher than the position they held before the course. But for those who had no experience, the entry jobs will probably be snow maker, rental shop attendant, lift operator or ski instructor. Opportunities exists across Canada and relocation may be required.

In time, graduates reach the supervisory level up to middle management positions at larger resorts. In smaller resorts, they become area managers. Other jobs exist in ski shops or schools, in the merchandizing of snow making and grooming machinery and in the distribution of ski equipment to retailers.

Curriculum

Semester 1	(30 hours/week)	
	Ski Lift Operation & Maintenance 1	3
	Snow Making & Hill Grooming	3
	Rental Shop Operation	2
	Principles of Accounting	2
	Ski Resort Management	3
	Area Layout and Design 1	3
	Ski Area Field Research	4
	Beverage Management	4
	Marketing	3
	English Communications	4
Semester 2	(4 winter months)	
	Field Work	7

A major educational field trip is included to give a realistic view of the industry and its personnel. A $150 fee will cover travel and living expenses. Alternative comprehensive projects are assigned to students unable to go on the field trip.

Field placement positions range from rental shop, snow making, ski instructing to ski patrol. You are encouraged to find your own job anywhere in Canada, but you will be assisted by a college supervisor if necessary.

Semester 3	(21 hours/week)	
	Ski Resort Food Management	3
	Ski Patrol & Risk Management	3
	Snowmaking & Hill Grooming 2	3
	Ski Lift Operation & Maintenance 2	3

Area Layout & Design 2	3
Ski School Management	2
Ski Resort Personnel Administration	2
Marketing Communications	2

At present no comprehensive programs are run in Alberta.

4.04 Marketing and Your Area Image

Marketing your ski area during and after construction is at least as important as any other component of your operating plan. You may recall that the market analysis in the concept and master planning phases is of similar importance.

The CWSAA and Travel Alberta can help substantially in this area.

The following article appeared in the magzine "Ski Area Management" and provides sound advice in the area of competitive strategy.

THE MARKETPLACE

by Jim Branch, President, Sno-engineering
and
Roger Prevot, the Gilette Company and Sno-engineering

COMPETITIVE STRATEGY

You are operating a medium-size ski area. You need financing for that new lift, trail system or building. The folks with the money you need don't believe that skiing is the growth sport it used to be. They want to know if there is little or no growth in the number of skiers in your market and if the ski industry has finally "matured", why your proposal represents a wise investment opportunity.

If this suspicion of industry maturity gets you haggling over market studies and statistics because you believe a growing market is a prerequisite for capital expenditures, you may be wrong in both approach and belief.

Let's assume that the total pie has stopped growing. So what? The "what" is that it is time to compete to keep your share of the pie growing. Just because skier visits nationwide may appear to be flat does not mean that your parking lot can't be full every day of the week, and it certainly should not prevent you from making necessary and important capital improvements.

Opportunities for success don't disappear as industries mature. It just takes a little insight to find them and a lot of commitment to capitalize on them. Evidence of this is provided by a few agile companies in the American steel and shoe industries which have built extremely profitable businesses under overall conditions far worse than what the ski industry sees in even the worst years. How have they achieved this success and gained the backing to build their operations? They have done what the successful ski areas of the future will be doing: they have taken the initiative to develop well-defined competitive marketing strategies and then they have organized their resources around those strategies. And their exceptional success has been at the expense of other companies that have failed to adopt such strategies. History dictates that there will always be winners and losers.

Haven't we seen that ski areas have started competing more vigorously in the past couple of seasons. Sure we have, but their style of competition has often hurt them both individually and collectively. Most areas have been trying to become better in all ways to all people and they are spending a lot of money to keep up with what other areas are offering. During this phase of the industry's development, wise competitive strategy is not "keeping up with your neighbor" or "being all things to all people", it is finding a meaningful way to be different from your neighbors, to develop an individual identity.

While you and the other operators of (medium-size) ski areas are spending money to keep up with all the offerings of the major resorts the number of skiers up for grabs may be staying about the same. (We don't believe that it is, although certain studies would appear to present it that way. We believe that the number of skiers is still growing steadily, but that the average number of days skied per season may be declining. Is this a reaction to price? This topic will be discussed in future articles and may offer interesting opportunities for new marketing thrusts.) This means that keeping up with everyone else only maintains your skier visits at the same level they were before you spent the money.

Without an increase in the number of tickets sold, you are forced to pass along higher development and marketing expenses to skiers by charging more for a day's skiing. Eventually, the more price-sensitive skiers drop out of the market, further inhibiting market growth, and thus hurting everyone concerned. So the current homogeneity of the industry isn't good for either ski areas or skiers.

Offering roughly the same skiing product as your competitors used to keep your own annual growth at about the industry's rate of growth. Now the only way to grow may be to steal business away from competitors. Formulating a competitive strategy that differentiates your ski area as much as possible from other areas will help you grab from them a bigger piece of the pie. That strategy of differentiation must focus your organization on becoming known to skiers as absolutely tops in one major dimension, such as most elegant, lowest cost, greatest challenge, friendliest for the family, most exciting for singles, best for beginners - to name a few possibilities.

This single-minded focus will allow your message to penetrate the advertising clutter and develop a clear, believable image among skiers. Your organization will then be able to focus its resources on delivering to its skiers the kind of experience promised by its advertising and promotion. Granted, you will now be attractive to a narrower range of skiers, but you will be memorably and meaningfully attractive to that specific group. Among these people there will be a very clear reason why your area is more worth traveling to than any other. If you have the courage and commitment to stick to your strategy, leaving dissatisfied those former customers who now do not fit with your new identify, you will be on your way to effective differentiation.

Here is a four-step process for developing a ski area competitive strategy:

1. See through your skiers' eyes in general, but particularly learn their perceptions, preferences and composition. This will require some penetrating and objective research, but it doesn't have to be expensive research.

2. Honestly and objectively evaluate your strengths and weaknesses as a ski area. Are you what you, your family and your staff think you are (want to be)?

3. Analyze your competitors' weaknesses and strengths. A careful analysis of your competitors will help you select a strategy that will be truly unique and difficult for your competitors to imitate once it brings you success.

4. Select your way to be different - your strategy - and in the process be sure to clarify for whom you will tailor your product. In doing this, look to the future and the shifts that may take place in other areas as well as your own.

Once you have a strategy, then you can plan what you need to do and how you need to allocate your resources to achieve this difference in the minds of your skiers. Begin with the physical aspects of the product you offer. What new lifts, buildings, grooming vehicles, snowmaking equipment or trails do you need to be recognizably different? Next, consider what it will take to communicate this difference and build the desired image among the skiers you seek to attract. This involves aligning the creative execution of ads, media selection and promotional programs with your strategy and its implementation schedule. Finally, you must seek out opportunities to change the way you operate your area - perhaps even change those "universally accepted" procedures - to contribute to this point of difference that you are trying to achieve. This could mean drastically trimming and streamlining one aspect of your operations, while generously investing in another. After all, if your market share isn't growing, why stick with an out-of-date or ineffective game plan?

Reprinted with permission from "Ski Area Management".

Your area image is very important. As mentioned in the reprinted article, how you are perceived can directly effect your attendance figures.

The image is not just winter but throughout the seasons. An untidy summer ski area not only can affect the environment but the image of your area perceived by non-winter visitors who may also be skiers.

Layout of maintenance and parking areas, friendliness and attentiveness or otherwise of staff, particularly in the lodge (where the most staff to customer contact occurs) is vital.

Another area where image is reflected concerns lifts and tows.

Generally speaking it is much more relaxing and comfortable to ride on an aerial lift, and this may attract skiers to areas with chair lifts.

Aerial lifts may be used in resort promotion to create a more sophisticated image and consequently attract more customers.

When considering the economics of purchasing a new lift the effect of the items mentioned above should be weighed carefully.

The following references contain useful additional information on the subject of marketing:

- "Ski Area Management"
- "Bibliography of Skiing Studies"
- "British Columbia Skier Survey"
- "Participation in Downhill and Cross-Country Skiing"
- "Profiles of Cross-Country and Downhill Skiers"
- "Ski Area Planning, Market and Management: A Selected Bibliography"
- "1976 Ski Industry Evaluation Study" (Alberta)
- "Ski Industry Evaluation Study: Executive Summary"
- "Special Industry Edition of the White Book (United States and Canada) 1983/84"

4.05 Legal and Insurance

All lifts and tows in Alberta must be approved and inspected regularly.

Inspections are made under the authority of the Elevator and Fixed Conveyances Branch and appropriate regulations. See Appendix "G" for the applicable legislation - the Elevator and Fixed Conveyances Act, Chapter E7 revised Statutes of Alberta 1980 and Alberta Regulation 268/80 (adopting the National Standard of Canada for Passenger Ropeways, CSA-CAN3-Z98-M78).

The program provides for:

1. The submission of drawings and specifications for review and record purposes in conjunction with the installation of new equipment or the alteration of existing equipment. Drawings are to be endorsed by a registered professional engineer and are to reflect industry standards and compliance with regulations currently in force. This data to be submitted prior to the start of site work.

2. Conducting inspections and witnessing tests on all new or altered installations on completion of work and before the units are placed in service.

3. Regular inspection on an annual basis of all existing installations prior to the start of operations at the beginning of each season.

In addition to the activities noted above, the Branch endeavours at all times to co-operate fully with the industry and operators to ensure timely and practical delivery of the program and to participate with the industry on a continuing basis in the promotion of lift safety.

All other facilities, utilities and services come under the usual development regulations and building codes. Regulatory agencies are listed in Appendix "B" as previously mentioned.

The following is a summary of information of insurance programs available for ski hills:*

Summary of Property Coverages

This program provides protection against all risks of direct physical loss for the following property:

COVERAGE A:
This section insures all your property including property of others for which you are responsible except portable equipment. Included in this section is coverage for:

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* Kindly supplied by Renfrew Insurance Brokers Ltd., Calgary, Alberta.

- buildings;
- stock;
- equipment; and
- tenants improvements.

COVERAGE B:
This section insures all your portable equipment including property for which you are responsible. Included in this section is coverage for:

- lifts; and
- grooming equipment.

PROPERTY NOT INSURED:

- vehicles licensed for general road use;
- documents, furs, jewellery;
- boats, motors, piers, docks, wharves; and
- property more specifically insured.

The property insured is against all loss of direct physical loss except:

- wear and tear;
- mechanical breakdown;
- electrical short circuits, unless fire ensues;
- property while being worked upon and the loss resulting from such work;
- infidelity;
- loss caused by rodents, vermin, insects;
- caused by sinking, expansion, contraction;
- mysterious disappearance;
- radioactive material;
- war; and
- loss of income.

The minimum deductible per claim is $500.00 and can be increased for credits on premium.

Some other pertinent clauses are:

1. Replacement Cost with no Site Clause.
2. Stated Amount Co-Insurance.
3. Consequential Loss Assumption Clause.
4. Automatic Acquisition Clause up to $100,000.00.

Loss of Income Insurance:

In the event that no operations or only partial operations are possible due to the happening of a peril insured against, this clause will provide the reduction in income less any costs that do not continue.

Summary of Liability Coverages

This insurance policy provides protection against liability imposed by law for bodily injury and/or property damage caused by negligence and arising out of the described operations.

Without limiting the above, the policy includes protection for:

- liability assumed under contract;
- false arrest;
- invasion of privacy, wrongful eviction;
- discrimination, humiliation;
- non-owned automobile used on your behalf;
- employers liability;
- fire fighting expenses up to $250,000.00;
- selling of alcohol beverages;
- voluntary medical payments of $2,500/$25,000;
- legal defense costs; and
- immediate medical and/or surgical relief as may be required at the time of accident.

In addition to protecting the named insured, this policy provides protection for the following people while acting on behalf of the named insured:

- the named insured
- partners)
- directors)
- executing officers)
- shareholders) while acting on
- members of the insured) behalf of the
- employees of the insured) named insured
- ski patrols)
- volunteers)

There are a number of situations where this policy does not provide protection. The following is a brief listing of some of the exclusions:

- losses insured under a Workers' Compensation law;
- injury to an employed individual who is under legal employment age;
- losses arising out of intentional acts;
- losses arising out of licensed self propelled motor vehicles;
- losses involving nuclear material or energy in any form;
- loss to property in the insureds care, custody or control;
- loss to the insured's products or property;
- loss arising out of the use of aircraft; and
- loss arising out of the use of watercraft.

Other Coverages Available

1. Valuable Papers
2. By-Laws Coverage
3. Accounts Receivable
4. Robbery, Theft
5. Infidelity of Employees
6. Excess Liability or Umbrella Liability
7. Automotive
8. Boiler and Machinery, Including Loss of Income
9. Directors and Officers Liability
10. Life Insurance
11. Employee Benefits

An indirect form of insurance is snow making.

Snow making costs can represent a substantial percentage of a lift ticket cost. This cost is to replace what normally nature provides free. If snow making is designed to preserve some skier-visits and revenues, in years where natural snow is short or non-existent, it is expensive insurance. Remember the snow making investment must also be carried during normal seasons.

4.06 Safety

1985 has seen the ski industry in both the United States and Canada mobilizing for safety. Safety awareness programs are being developed with the objectives of educating skiers about risk and safety.

Skier safety acts are being legislated in the United States and action is anticipated in Alberta.

Ski patrollers will be trained in procedures for dealing with reckless skiers.

The following review was taken from from the report "Ski Resort Planning and Development".

Ski Patrol

On the major ski fields this is a service that is required to be provided by the ski field operator or the lift company. Ski patrol personnel are top skiers, qualified in first aid. They are responsible for the welfare of the skiers. Their duties can include such tasks as -

i) Marking slopes.
ii) Checking slope conditions and marking off hazardous areas.
iii) Clearing the slopes each night.
iv) Avalanche patrol, although this is a specialist job.
v) Rescue of injured skiers.
vi) Checking lift lines.
vii) Checking the behaviour of skiers.
viii) General public relations.

Ski field managers usually prefer local skiers for this work as they have a good knowledge of the field conditions.

Avalanche Control

As mentioned above, this is a specialist field, but in areas of avalanche risk the ski field proprietor has to look after the aspect of safety. Usually there is one or more members of the avalanche patrol who monitor snow and weather conditions to check the "safety" of the potential risk areas.

Explosives are used to precipitate the avalanche or settle the snow down so it becomes stable. Hand charges can be laid or mortar bombs fired from fixed sites or charges fired from 75 mm and 105 mm recoiless rifles into the suspect areas. The charges are set off at night or very early in the norning before skiers are on the slopes.

It is important to identify and avoid avalanche sites when in the planning stage of new resort development.

Rescue System

Codes and standards generally demand a rescue system for large cabin reversible tramways that operate at extreme heights, over water or over inaccessible terrain. A small rescue carrier with its own auxiliary power rides on the cables of the main tramway and passengers are transferred from the stranded carrier to the rescue carrier.

Carriers can be evacuated to the ground via ropes, ladders or mechanical equipment. However, trained personnel are needed to undertake the task, which is usually difficult in such terrain and in freezing conditions.

Safe operating procedures are spelled out in various equipment manuals for lifts, tows, snow making and grooming, etc.

See also Section 4.02 for safety aspects of your ski area operating plan.

For further information there are:

- Series of articles such as "Keeping Safe" and others in "Ski Area Management".
- "General Lift Safety".

4.07 Snow Making

System Operation*

Water System

The firm that does the engineering or supplies the material, should provide operating instructions. Basically they will say to set up your guns on the hill and then with one man on the hill and one in the pumphouse, start up the pump. Walkie-talkies are often used between hill and pumphouse.

As the pump pressure increases, the man in the pumphouse will keep the line pressure to a predetermined figure by regulating the by-pass valve. At the same time the hill personnel will gradually start up the guns with the pumphouse man continuing to set the by-pass valve to maintain the pressure. Automatic by-pass valves or variable speed drivers eliminate the hand pressure regulation on most large systems.

Air System

The air compressors will have been started before the pump and will load or unload automatically to keep the pressure at a normal level. The basic monitoring here is to see that so many guns are not turned on that the air pressure drops below the efficient level necessary for the guns.

Hill System

For the fans units, the fans will be started and then when the pump pressure is up to normal, hand regulation of the water flow on the units as per the manufacturers instructions will be done to secure the desired quality of snow.

For air water guns, a normal procedure would be as noted below and assume that the guns are being fed with air and water at the correct temperature and pressure. A good gun will not perform well on a poor system be it a fan gun or compresses air gun.

Snow Quality

The quality of snow to be produced varies with application and management preference.

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* Derived from "Ski Resort Manual" (Ontario).

Generally, snow should be made as "wet" as possible. Dry, loose snow looks nice, but may cost twice as much to produce (energy costs) as "normal" man-made snow. If the snow produced does not "crust-over" within an hour or two and require machine working, the snow being produced is probably too dry. Another indication of snow quality is its snowball-making qualities. Proper snow would be considered "good packing" - not so dry as to fall apart and not so wet as to bleed water when packed.

At the beginning of the season it is common practice to produce "basetype" snow. This is essentially a frozen sub-base upon which skiing snow is placed. Base-type snow is usually produced in an extremely wet consistency and allowed to freeze.

Adjusting Snow Quality

The snow making gun is put into operation by first partially opening the water hydrant and when water begins flowing out of the gun nozzle, fully opening the air hydrant. It is now necessary to adjust the airwater combination to produce snow of the desired quality.

Initial adjustments are made by adjusting the water hydrant, leaving the air hydrant fully open. Snow quality is checked by walking out to approximately the first third of the pattern and allowing the snow to fall upon an upturned arm. Snow which is too dry will bounce off the clothing. Wet snow will show up as mixed snow and water particles. With practice, snow quality can be accurately determined by this method. The water is either increased or decreased until snow of the desired consistency is obtained.

Optimum snowgun efficiency (at temperatures below approximately -3o C) is realized when large, crystalline flakes (resembling the structure of natural snow) are produced, rather than fine ice particles.

For any given condition, there is an ideal air pressure at the nozzle that produces the desired crystalline snow flakes. This point can only be obtained by hand regulating air volume (cutting back on air) and visually inspecting snow quality.

This adjustment is made only after the initial water adjustment is made to obtain suitable snow consistency.

By making this adjustment, snow production efficiency increases approximately 30%.

Snow Gun Adjustment

The nozzle of the snow making gun should be elevated a minimum of 45 deg. above horizontal for ideal efficiency. The higher the nozzle is pointed in the air, the greater the water conversion (efficiency)

of the snow making gun because the water particles have a greater opportunity to freeze. Wind is usually the limiting factor governing nozzle elevation.

Snow making guns are usually positioned so that wind is used to carry snow away from the gun position and distribute it on the slopes. Snow is usually made with the wind. An exception is in high winds; extremely high winds often tend to retard snowflake formation, immediately freezing water droplets into extremely fine ice particles and blowing them away. It is best to make snow into the wind in this case.

System Checking

Once the system is set up and guns are operating correctly, regular checks -- perhaps every half hour -- of each gun and its snow product and the operating conditions of pumps and compressors should be done. This ensures that any changes in operating conditions -- temperature, wind, water level, etc. will not cause the production of incorrect snow quality, placement, etc. Continual recording of the variable found during a shift is very important to give an overall view of your system performance, where it can be improved, etc.

The operation and maintenance of snow making equipment should be carried out in accordance with manufacturers and/or the design engineers instructions. Control equipment and guns are often nowadays computerized and requires familiarization with the relevant operating manuals.

4.08 Lifts and Tows*

Regardless of the thoroughness of spring/summer lift maintenance program, a last minute pre-operational check and re-check helps to improve the reliability factor so necessary for chairlifts.

In fact, many conscientious lift operators perform such re-check inspections on weekly basis with even portions on a daily basis - and it pays dividends in the improved reliability and safety of your lift operation.

While the major spring/summer maintenance program on each lift should have included thorough checking of structures and machinery, complete re-lubrication of all bearings, pivots and the rope, as well as detailed check of the operating and safety controls, the pre-operational check is intended to be mainly a "look and listen" inspection to points that may have been missed, items that may be nearing failure due to vibration, wear or fatigue, or noting any incomplete previous maintenance or repairs or outright vandalism -- all factors that could lead to major lift failures if not caught in proper time.

As an aid to carrying out such "look and listen" inspections, the following check-list outline (Table 22) constitutes a suggested basic guide for any lift, any make, any age:

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* Derived from "Ski Resort Manual" (Ontario).

TABLE 22

A Pre-Operational "Look and Listen" Checklist for Lifts

1. Lower Terminal Structure
   - housekeeping (d)
   - fire extinguisher (d)
   - loading ramp (d)
   - signs (d)
   - phones/bells (d)
   - foundations/attachment (w)
   - weld integrity (visual/hammer) (w)
   - bolt integrity (visual/torque) (w)

2. Upper Terminal Structure
   - housekeeping (d)
   - fire extinguisher (d)
   - unloading ramp (d)
   - signs (d)
   - phones/bells (d)
   - emergency equipment (d)
   - foundations/attachment (w)
   - weld integrity (visual/hammer) (w)
   - bolt integrity (visual/torque) (w)

3. Drive Equipment (Static/Operating):

   - alignment (couplings/shafts)
   - prime mover
   - auxiliary engine
   - belts, chains
   - service brake
   - emergency brake
   - anti-rollback
   - fluid levels
   - gears
   - hydraulic brakes
   - auxiliary engine
   - mounting bolt integrity (visual/torque)

4. Tension Equipment
   - counterweight position
   - counterweight system
   - carriage wheels
   - rails (level)
   - weld & bolt integrity

5. Rope

- splice/tucks condition	(d)
- surface rust/corrosion	(w)
- wear evidence	(w)
- broken wires	(w)

6. Electrical

- normal operating circuits	(d)
- fault circuits	(d)
- battery conditions	(d)
- instruments/indicators	(d)
- connections integrity	(w)
- insulation integrity	(w)
- contacts condition	(w)
- grounding verification	(w)

7. Chairs

- grip seating	(d)
- grip condition	(d)
- seat condition	(d)
- hanger structural integrity	(w)
- seat bolts (visual/torque)	(w)

8. Towers

- pivot shaft (tower axle bolts)	(d)
- linear wear	(d)
- sheave bolts (visual)	(d)
- sheave assembly alignment	(d)
- foundation/attachment	(w)
- structure and arm weld and bolting integrity	(w)

For particular lifts, additional items may be added, as needed. Items suggested also for daily pre-operation inspection are marked with (d), items suggested also for weekly inspections are marked with (w).

SOURCE: "Ski Resort Manual" (Ontario).

Rope Rotation on Tows

Interwoven rope tends to twist or rotate when the tow is in operation. Several serious accidents on tows have resulted from this rope rotation or twisting. The rotation should be limited to no more than two complete turns in 600 feet. The rotation can be reduced by careful installation and alignment of sheaves especially the head sheaves. Braided rope will also reduce twisting.

Excessive rotation is caused by:

- improper type of rope;
- rope spliced with turns in it;
- angular leads into and out of sheaves at other than 90^{o} axis;
- rope bearing on any stationery object, causing helical action (spirally); and
- rope slippage in drive sheaves, causing helical action.

The following article appeared in the Kendall Report (February 1980):

Rope Twist, An Old Story

A recent discussion involved the first form of uphill transportation for skiers, the rope tow. Highlighted here are some of the suggested solutions for the ever-present problem of rope twist.

* Sheave Misalignment: If care is not taken to install the lift so that all line sheaves are correctly lined up with the top and bottom terminal sheaves, twisting of the rope will occur. The idler sheave at the drive terminal should be canted to help prevent rope twist.

* Improper Track Location: An uphill track that does not parallel the lift line can cause the rope to enter the top sheave at an acute angle, thereby causing the rope to twist. Be sure the unloading area track is aligned with the top terminal sheave and permits the rope to enter the sheave in a straight line.

* Convex Track Profile: The lay (direction of strands) of the rope that drags on the ground tends to create a screw effect on the rope and a twisting action when the lift is operating without skiers riding the lift. Design the track slope profile and lift line within code limits so the lift operates with a minimum amount of rope drag on the snow.

* Incorrect Rope Construction: Use only hard lay twist resistant rope designed for use on a ski tow. Hard lay rope may be difficult to splice, but will cause fewer problems and give extended service.

* Rope twist can also be caused by improper reeling for shipping by the manufacturer. One method of correcting this situation is to take the rope off the lift and drag along the ground for about a half mile in both directions. This procedure has the same effect as dangling a telephone handset cord to remove the kinks. As the rope is dragged over the ground, the ends will unwind and the twist is eliminated.

Some other factors to consider when designing a rope tow installation:

* Although a base drive lift requires a counterweight to maintain rope tension, there are some advantages in driving the tow from the base. Bottom drive tows permit the operator to observe the loading area and the line. Availability of power or delivery of fuel to a base drive terminal is usually more convenient.

* Top drive lifts are the most desirable and reduce rope twist potential due to the lighter tension on the rope. Proper rope tension is easier to maintain with a top drive and requires less power to "pull" the load uphill on one side of the line. Most rope tows have relatively flat loading areas with unloading areas at the top on a slope. A top drive tow installation permits the operator to observe the entire line and the unloading area where the accident potential tends to be greater.

* An encircling safety gate must be constructed at the top station so as to make the gate unavoidable if a skier becomes entangled in the rope. Be sure snow build-up at the gate doesn't prevent skiers from tripping the gate in an emergency. As in all surface lift safety gates, maintain a set of tracks through the gate area to indicate the direction of travel when approaching the gate.

* Select the right size motor or engine. If an internal combustion engine is used, continued operation of the engine at slow speeds can result in carbon build-up in the engine and create a diseling effect when the lift is shut off. Speed governors should be removed from the engine so the operator is required to maintain constant supervision of the power plant. Reverse gear should be blocked or removed from the transmission of converted tractor or truck power plants used to drive the tow to prevent an accidental reversal of the tow. Backstop brakes are required by the code for certain rope tows that can roll backwards.

* Support towers for downhill rope sheaves should be free from protruding obstructions such as spikes or hooks for the hang-up of the rope when the lift is not operating. These hooks should be at least 7 feet above the snow and mounted on the back side of the support. If line sheaves are mounted on trees, be sure tree growth does not prevent the sheave from turning freely. Pipe support towers can rust or corrode at the base after extended use. Annual inspection of the pipe posts should be done prior to each operating season to check for corrosion or wood rot if wooden supports are used.

* Often dual tire wheels are used for return line sheaves, but the rubber tires tend to chafe the rope and cut down on the usable lift of the rope.

* Spacing of return sheaves should be about 100 feet apart and allow the rope to sag only 1-2 feet between support posts.

* Check Section II of the ANSI B77.1 Code for design and installation requirements when planning a rope tow facility.

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Care of Rope

Manila:
- should be kept off the ground when not in use; and
- in the off-season, the rope should be coiled and hung in a cool, dry place.

Synthetic:
- can be left on the ground overnight, but it may freeze to the snow.
- in the off-season, it should be stored under cover.

Sunlight is very destructive to both manila and synthetic rope.

Surface lift lanes require almost continuous maintenance during operating hours, because of rolls and icy conditions caused by the action of skis on them.

4.09 Grooming

The following review is derived from the "Ski Resort Manual" (Ontario).

In the present day advancement of ski facilities, it has become generally a basic requirement for any ski area to maximize the quality of the snow conditions in order to remain competitive in the ski industry. Similarly, as snow making has become a necessity, snow grooming must naturally follow. It is therefore the purpose of these pages to summarize the format of the procedure of hill grooming.

Basically, in order to carry or pull the necessary equipment for the grooming process a large and dependable machine is required. Although a fairly wide assortment of such machines is available on the market today, each individual resort will have specific user requirements which will dictate the selection of a specific model.

1. Hill: Height, vertical drop, number of trails, trail gradients, trail skier densities, type of trail, type of land cover and percent, rock, soil or vegetation, grooming time per trail, type of obstacles and machine diversion time, full length of all runs, average widths, sun time per day, water sheds, run off pattern.

   Investigate any unusual conditions around the area that might affect operations (altitude, ground cover, road surfaces, etc.)

   Define purposes and operations for which machines are to be used (grooming, equipment, transportation, snow making, etc.)

   Determine by technical data available (and by operations, demos, etc., if possible) which machines are best for each job you have in mind.

   Determine how many machines and equipment you need for each purpose or purposes and cross-match with the data available.

2. Evaluate speed, safety factors, initial capital investment, payback rates and interest charges, approximate fuel consumption, parts delivery service, normal amounts of stock needed on hand, delivery rates, spare parts, maneuverability, stress patterns.

   Review cost prices of machines and accessories and pros and cons of financing arrangements available for each.

3. Include depreciation, tax, inventory, advantages, etc. and compare. Check reputation and warranties, etc., of machine, dealer, manufacturer, etc.

From above data, determine the best machine and accessories available to do the required jobs at the lowest cost.

4. Attachments: Job description in full, relating to which machine, safety factors, initial capital investment, payback rates and interest charges, replacement parts service, delivery dates, adaptability of equipment, ease of repair.

5. Support Systems: staff size, 3 shifts, sickness and relief (holiday), training by factory drivers and maintenance personnel, preventative maintenance system, service building size and convenient location, portable and stationary maintenance equipment, patterns, all equipment should be estimated for life span vs. capital investment return time.

6. Weather: snow depths, prevailing wind direction, weather patterns.

The hill groomer's job is the operation of the machine with particular grooming equipment to condition the snow surface to provide the best type of snow conditions to satisfy the customers. In order to do such a job well, the groomer must become totally familiar with the operation and availability of the machine and equipment and maintain such in perfect operating condition.

In addition, the groomer must be aware of what conditions the skiers want and how to judge the best ways of achieving such conditions. In practice, it has been found that the best way for a groomer to know how to satisfy the skier, is to be a skier himself. Hence, if the groomer has to ski the conditions he develops, he will naturally try to obtain perfection.

In order for a groomer to be efficient at his job, he must be able to identify the immediate snow conditions present and know which piece of grooming equipment to use in order to obtain the improved conditions desired. This information must then be balanced with additional information such as what environmental factors will have immediate future effect on the results desired. For example, if it is known that high winds may develop shortly after creating light powder conditions, it would not be advisable to make powder where it will be swept off the slopes.

Other important information such as the number of various level skiers to use the particular slopes could also have immediate effect on what is to be done to those slopes. For example, if it were known that a large number of beginners were to use certain runs, on the next day, it might be necessary to cut off all the moguls or break up a slightly ice condition which would otherwise not hinder the usual advanced skier that uses the run.

In most cases it is generally the rule that the type of snow dictates which equipment should be used. The following chart gives the general outline: of common snow conditions and corresponding grooming procedures.

SITUATION	PROCEDURE
Light	- pack with roller - large radius turns
Wet	- pack as above - caution recommended if working in near freezing (+ or -) tempertures - snow should set in smooth state - groomers avoid chopping snow - long radius turns NOTE: Compacter bar should be substituted for roller.

Hard Packed

Non-Icy Conditions:
- dragged with chain or link wire mesh - roller after loosened;
- aim is to loosen snow and create a soft pack situation; and
- moguls should be planned prior to making and rolling.
* ONLY if roller is clogging due to wet snow.

Icy Condition:
- 3-5 gang powder maker; and
- then rolled to prevent wind erosion - scarifier bar should be used in front of powder maker.

White Ice

- snow should be turned up with scarifier discs or tine-harrower pulled by wide tracked vehicles; and
- re-groomed with powder maker (3 or 5 gang) then rolled to prevent wind erosion.

Moguls

Icy Conditions:
- plowed or graded with wide track vehicle; and

- broken up with discs or tine-harrower (or by several passes with vehicles and screen attachment) then rolled with powder maker and finally rolled to ensure no wind erosion.

Non-Icy Conditions:
- plowed or graded with screen or mesh attachment to break up chunks; and
- rolled to ensure no wind erosion.

Spring Conditions

Wet Snow:
- chain mesh or screen to break up small ruts and stumps.

Moguls:
- plowed or graded following above procedure to break up snow - roller should be used to compact and level terrain.

Early and Late Season (Little Base)

Fall:
- vehicles should remain off hill till sufficient base is built up, to ensure no damage due to tracks - turning, climbing, etc.

Spring:
- plow and even out snow till base wears thin; when base thins out vehicles should be removed from service.

NOTE: Whenever a vehicle is on the ski surface it should be towing:

- either powder maker or roller to cover any rubs left by tracks; or
- vehicles should not be near areas being covered by snow making process.

New Snow from Snow Making System

- when 'set' crust is run over with hill grooming vehicle then rolled - avoid new areas as moist snow will severely clog powder maker.

By using such an outline for basis to work from, an experienced groomer can rely on his own judgement as to the best method of operation to achieve the necessary product.

Also considerable time and operational cost savings can be obtained by developing specific grooming patterns. This includes using the terrain to assist your machine in operating at maximum efficiency. Lower level skier terrain and heavy use areas should be groomed first.

A hill grooming machine is a highly specialized vehicle designed for a particular purpose and hence care, caution, experience and driving skills are a necessity for operation. Contrary to popular belief, these machines are terrain restricted since they do not possess a totally unlimited scope of ability.

4.10 Base Facilities

The day to day operation and maintenance of base facilities such as a lodge or warm up area and ski rental shop is beyond the scope of this manual. For facilities themselves the usual building maintenance procedures apply. The various education and job training programs outlined in Section 4.03 deal with the aspects of food and beverage, ski retail/rental shop management. Some of the courses also deal with preventive maintenance.

There are also many articles on aspects of base area operation and maintenance to be found in the magazine "Ski Area Management".

GLOSSARY OF TERMS

ASPECT (or explosure)

The position or terrain facing a particular direction. North aspect faces north.

CATENARY

The curve assumed by a perfectly flexible cord of uniform density and cross section hanging freely from two fixed points.

COHESION

Attraction between surfaces which are alike. Examples: a slab is an example of cohesion. This slab has little adhesion to other snow surfaces. In the process of destructive metamorphism we find cohesion between the ice crystals.

COMPRESSION ZONE

An area of compression at the base of the slide path. This zone is concave in profile, and subject to gravitational pressure from the snow above.

CONCAVE

The interior of a curved surface. A shallow and rounded surface.

CONVECTION

Transfer of heat or mass by turbulence.

CONVEX

The exterior of a curved surface.

CORN SNOW

A type of damp or wet spring snow. Example of destructive metamorphism in advanced stages.

CRUSTS

Breakable, unbreakable and variable.

Wind Crust: bend to underlayer.
Slab - A layer of snow of different structure than adjacent layers.
Rain Crust - very hard.

FALL LINE

A line perpendicular to the contour, having the greatest pull of gravity. For instance, the line a round ball would roll down if the slope was free of obstructions.

LEE

Side of a slope. The side sheltered or protected from the wind. An eastern aspect would be the lee side for a western wind. (See also windward.)

MEASUREMENT OF SNOW

Four types of stakes used:

1. Fixed or Master. Made from 2" x 2" and measures total winter snowfall.
2. Storm Stake - measures total snowfall of one storm.
3. 24-Hour Stake - measures snowfall over a period of 24 hours. Constructed same as No. 2.
4. Interval Stake - measures snowfall over short interval of 1 hour, 2 hours, 4 hours, etc. Made same as No. 2.

SETTLEMENT

Totals snow depth as at previous day	+	New snow in previous 24 hours	-	Total depth at time of observations	=	Settlement
e.g., 152 cm (60")	+	25 cm (10")	-	165 cm (65")	=	12 cm (5")

MOISTURE CONTENT IN SNOW

1. Dry - cannot make snowball.
2. Moist - can make snowball, but no water visible.
3. Wet - liquid water visible.
4. Slushy - liquid water squeezed out with light pressure.

P.A.O.T. (PEOPLE AT ONE TIME)

Is the sum of the SAOT and number of non-skiing visitors.

RATED UPHILL CAPACITY

The manufacturer's rated number of skiers per hour a lift can transport to the top of the lift. An area's hourly capacity is the sum of the individual lifts.

S.A.O.T. (SKIERS AT ONE TIME)

The sum of skiers on the slopes, on lifts, standing in line and in the base area, equals the total skiers at one time.

S.I. (SNOWFALL INTENSITY)

Rate at which snow is deposited during a storm - expressed in inches of snow per hour.

SKIER VISIT

One person visiting a ski area for all or any part of a day or night for the purpose of skiing. This is the total number of lift tickets issued. Skier visits include a full-day, half-day, night, complimentary, adult, child, season and any other ticket types that give a skier the use of an area's facilities.

SKIER (COMFORTABLE) CARRYING CAPACITY (SCC)

The number of skiers that a given ski area can comfortably support on the slopes, lifts and in the base and mountain warming accommodated at one time and still preserve a congenial environment. A ski area's comfortable carrying capacity is a function of VTM (VTF)/hour, difficulty of terrain, and scope of support facilities.

SLAB

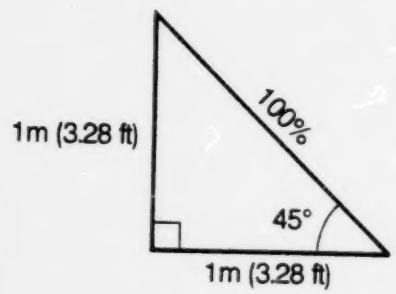
A layer of snow held together by internal cohesion. Wind is often a predominate but necessary factor.

SLOPE

Measured in terms of degress or percentage (See Figure 22).

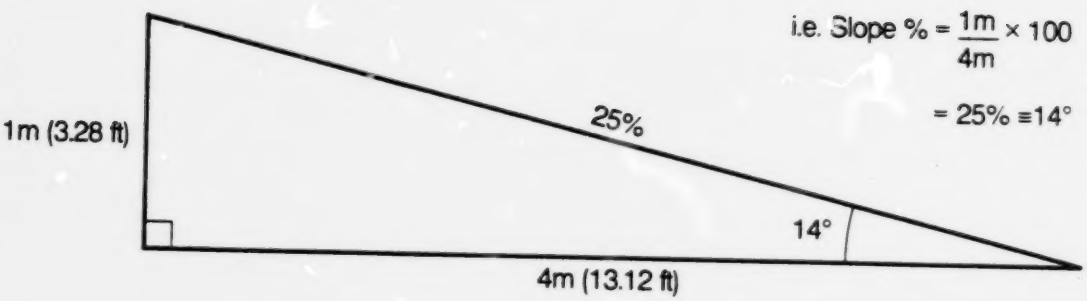
FIGURE 22

Slope Percent Calculations



i.e. Slope % = $\frac{1m}{1m} \times 100$

= 100% ≡ 45°



i.e. Slope % = $\frac{1m}{4m} \times 100$

= 25% ≡14°

SNOW PIT

A hole dug in the snow cover to expose the various layers (profile of the stratification). Some of the information which can be gathered is: thickness of layers, crystal structure, hardness (resistance), temperature, and density.

TERRAIN POD

A continuous area of land deemed suitable for ski lift and trail development due to its slope gradients, exposure and fall-line characteristics.

TRANSITION OF A SLOPE

Any point where the profile (grade) makes a sharp change.

UTILIZATION

Is measured as a percent of comfortable carrying capacity. Capacity is the product of a ski area's daily capacity times its days of operation. Utilization compares actual skier visits to calculated comfortable seasonal capacity.

VTF/HOUR (VERITICAL TRANSPORT FEET PER HOUR)

The number of people lifted 1,000 vertical feet per hour (vertical rise of a lift times the lift capacity per hour divided by 1,000). An area's total VTF is the sum of VTF for all lifts. VTM/hour is the metric equivalent.

WINDWARD SIDE OF A SLOPE

The side from which the wind blows. A western aspect would be the windward slope for a wind blowing from the west (opposite of lee side).

APPENDICES

APPENDICES

A. Sources for Maps

B. Regulatory Agencies

C. Ski Associations

D. Planning and Other Consultants

E. Wind Chill Factors and Tables

F. Required Facility Areas

G. Elevator and Fixed Conveyances Act

APPENDIX "A"

Sources for Maps

ABSM DISTRIBUTION NETWORK

Alberta Bureau of Surveying and Mapping
Alberta Energy and Natural Resources
804, J.J. Bowlen Bldg.
620 - 7th Avenue, S.W.
CALGARY, Alberta
T2P 0Y8 (403)297-7389

Alberta Bureau of Surveying and Mapping
Alberta Energy and Natural Resources
Sun Centre, 3rd Fl.
530 - 8th Street, S.
LETHBRIDGE, Alberta
T1J 2J8 (403)329-5424

Distribution Services
Alberta Bureau of Surveying and Mapping
Alberta Energy and Natural Resources
2nd Fl., North Tower, Petroleum Plaza
9945 - 108th Street
EDMONTON, Alberta
T5K 2G6 (403)427-3520

PUBLIC LANDS SUBAGENTS

Subagent of Public Lands
Alberta Energy and Natural Resources
Rm. 3001, Provincial Bldg.
10320 - 99th Street
GRANDE PRAIRIE, Alberta
T8V 6J4 (403)538-5260

Subagent of Public Lands
Alberta Energy and Natural Resources
Box 1959
ST. PAUL, Alberta
T0A 3A0 (403)645-6336

Subagent of Public Lands
Alberta Energy and Natural Resources
Bag 900, Box 35
Provincial Building
PEACE RIVER, Alberta
T0H 2X0 (403)624-6116

District Supervisor
Alberta Energy and Natural Resources
Box 1660
BARRHEAD, Alberta
T0G 0E0 (403)674-3351

District Supervisor
Alberta Energy and Natural Resources
Rm. 116, Chinook Place
MEDICINE HAT, Alberta
T1A 0L1 (403)529-3677

JASPER

Superintedent
Jasper National Park
Parks Canada
P.O. Box 10
JASPER, Alberta
TOE 1E0 (403)852-6161

LETHBRIDGE

Boy Scouts of Canada
Southern Alberta Region
217 - 12th Street A, S.
LETHBRIDGE, Alberta
T1J 2S9 (403)327-4647

MEDICINE HAT

The Bookshop
417 - 3rd Street, S.E.
MEDICINE HAT, Alberta
T1A 0G9 (403)527-7055

BANFF

Banff Book and Art Den
123 Banff Avenue
Box 1420
BANFF, Alberta
TOL 0C0 (403)762-3919

PINCHER CREEK

Jackson Brother's Hardware Ltd.
P.O. Box #730
PINCHER CREEK, Alberta
TOK 1W0 (403)627-5025

Outwest Sports Ltd.
988 Main Street
P.O. Box 2260
PINCHER CREEK, Alberta
TOK 1W0 (403)627-5025

WATERTON PARK

Environment Canada - Parks
Waterton Lakes National Park
WATERTON PARK, Alberta
TOK 2M0 (403)859-2262

Waterton Natural History Association
P.O. Box 145
WATERTON PARK, Alberta
TOK 2M0 (403)859-2624
or (403)859-2454

EDMONTON

Western Remote Sensing Ltd.
Room 3, Hangar No. 8
Municipal Airport
EDMONTON, Alberta
T5G 2Z3 (403)452-1267

Superintendent
Banff National Park
P.O. Box 900
BANFF, Alberta
TOL OCO (403)762-3324

Monod Sports
Harmony Laine
Box 310
BANFF, Alberta
TOL OCO (403)762-4571

The Alpine Club of Canada
P.O. Box 1026
BANFF, Alberta
TOL OCO (403)762-4481

CALGARY

Boy Scouts of Canada
Calgary Regional Council
2140 Brownsea Drive, N.W.
Box 3247
CALGARY, Alberta
T2N 3G9 (403)283-4993

The Hostel Shop
1414 - Kensington Road, N.W.
CALGARY, Alberta
T2N 3P9 (403)283-8311

Carter Mapping Ltd.
840 - 6th Avenue, S.W.
Room 200, 2nd Fl.
CALGARY, Alberta
T2P 3E5 (403)264-1230

Distribution Services
Alberta Bureau of Surveying and Mapping
Alberta Energy and Natural Resources
2nd Fl., North Tower, Petroleum Plaza
9945 - 108th Street
EDMONTON, Alberta
T5K 2G6 (403)427-3520

The Map Store
North West Survey Ltd.
Deville Bldg.
17203 - 103rd Avenue
EDMONTON, Alberta
T5S 1J4 (403)483-8033

Bookstore
University of Alberta
New Students Union Bldg.
The University of Alberta
EDMONTON, Alberta
T6G 2J7 (403)432-4215

Jerry Bricker's Frontier
Fishing Lodge
P.O. Box 4550
EDMONTON, Alberta
T6E 5G4 (403)433-4914

GRANDE PRAIRIE

Grande Prairie Hot Air
Balloon Events Association
P.O. Box 212
GRANDE PRAIRIE, Alberta
T8V 3A4 (403)532-6095

APPENDIX "B"

Regulatory Agencies -
Development and Operation of Ski Areas

NOTE: This appendix does not apply to projects located on Federal Crown Land, National Parks or Indian Reserves, nor Provincial Parks.

ITEM	AGENCY
- Preliminary development approvals (if on Alberta Crown land - a prerequisite to issuance of a surface lease).	- Preliminary disclosure co-ordinated through Alberta Energy and Natural Resources.
- Surface lease (if on Alberta Crown land).	- Public Lands Act administered by Alberta Energy and Natural Resources, Public Lands Division.
- Development approvals/permits*.	- Planning Act - relevant administrative planning body, i.e., Northeast Alberta Regional Commission, Improvement District (I.D.), Municipal District (M.D.), incorporated settlement with its own approved planning department.
- Construction approvals/permit.	- Uniform Building Standards Act - relevant administrative building inspection department otherwise as above. (In some instances Alberta Labour, General Safety Services Division, Building Standards Branch).
- Public access roads.	- Public Highways Development Act, Alberta Transportation. NOTE: 1) For minor forest access roads consult Alberta Energy and Natural Resources, Forest Service. 2) Consult also as necessary, relevant municipal organizational, e.g., M.D., town or city highways departments.

* If located in a special management area, for example Kananaskis Country, approvals would go through the Kananaskis Country Interdepartmental Committee. In essence Kananaskis Country was established under the Improvement Districts Act.

ITEM	AGENCY
- Cultural/historical resources (on a particular site)	- Historical Resources Act administered by Alberta Culture.
- Environmental Impact Assessment - usually applies to "Green Zone" areas.	- Land Surface Reclamation Act and Ministerial direction - Alberta Environment.
- Fisheries, protection of habitats.	- Federal Fisheries Act - administered by Alberta Energy and Natural Resources, Habitat Branch of Fish and Wildlife Division.
- Hydrological concerns, e.g., surface water (watershed) interference, flood plain intrusion/disturbance.	- Water Resources Act and Ground Water Development Act - Alberta Environment, Water Resources Administration Division.
- Timber salvage.	- Forests Act - administered by Alberta Energy and Natural Resources, Forest Service.
- Sewage disposal and plumbing permits (if outside municipally serviced area).	- Clean Water Act - administered by Alberta Environment, Standards and Approvals Division, Municipal Engineering Branch and/or Plumbing and Drainage Act - administered by Alberta Labour, General Safety Services Division, Plumbing and Gas Safety Services Branch.
- Garbage disposal.	- Public Health Act - Local Health Unit.
- Incineration.	- Clean Air Act - Alberta Environment, Standards and Approvals Division, Air Quality Branch.
- Water including that used for snow making.	- Water Resources Act - Alberta Environment, Water Resources Administration Division.
- Water treatment.	- Clean Water Act - Alberta Environment, Standards and Approvals Division, Municipal Engineering and Water Quality Branches.
- Pipelines (e.g., water for snow making)	- May come under the Pipeline Act - administered by Alberta Environment.

ITEM	AGENCY
- Lifts and tows installation and operation.	- Elevator and Fixed Conveyances Act - administered by Alberta Labour, General Safety Services Division, Elevator and Fixed Conveyances Branch.
- Plumbing, electrical, heating, gas installations and fire protection.	- Various acts: Boilers and Pressure Vessels Act; Electrical Protection Act; Fire Prevention Act; Gas Protection Act; Plumbing and Drainage Act; Uniform Building Standards Act. Relevant municipal department or Alberta Labour, General Safety Services Division, Boilers Branch, Electrical, Protection Branch, Fire Prevention Branch, Plumbing and Gas Safety Services Branch.
- Food services equipment.	- Public Health Act - administered by relevant authority
- Occupancy Permit	- In accordance with building permit.
- Special off-highway vehicles.	- Off-Highway Vehicles Act - administered by Alberta Transportation.

GENERAL NOTES:

1. In addition to the proceding list, the usual conditions that apply to any business also apply to a ski area operation, for example:

   - Relevant local bylaws e.g., for food services (Public Health Act, etc.)
   - Business Licences
   - Liquor Control Act
   - Labour Relations Act
   - Occupational Health and Safety Act
   - Labour Act
   - Workers' Compensation Act

2. As a final check, the list of current acts should be reviewed.

3. A number of government agencies may also have a policy or general interest in the development of a particular ski area and should be consulted for advice and potential support for any formal development application. Examples are:

   - Integrated Resource Plans under "A Policy for Resource Management of the Eastern Slopes Revised 1984" (Projects on Alberta Crown land).
   - Travel Alberta for the tourism-related aspects of any project.
   - Alberta Recreation and Parks, Recreation Development Division.

APPENDIX "C"

Ski Associations

Canada West Ski Areas Association (CWSAA)
Suite #103, 3313 - 32 Avenue
VERNON, British Columbia
T1T 2M8
Phone: (604)542-9020

Canadian Ski Association -
Alberta Division - Alpine
423A - 38 Avenue, N.E.
CALGARY, Alberta
T2E 6R9
Phone: (403)277-3969

Canadian Ski Patrol System
(Mountain Division)
1333 - 16 Avenue, S.W.
CALGARY, Alberta
T3C 0Z7
Phone: (403)262-6232

Alberta Association for Disabled Skiing
Box 875
Postal Station M
CALGARY, Alberta
T2P 2J6
Phone: (403)228-0236

Alberta Sport Council
4th Floor
101 - 6 Avenue, S.W.
CALGARY, Alberta
T2P 3P4
Phone: (403)297-2503

APPENDIX "D"

Planning and Other Consultants

Name	Service
* Alford International Inc. Box 25, Station B LONDON, Ontario N6A 4V3 Phone: (519)679-8240 President: Peter B. Alford (519)471-3543 (res)	Engineering consultants for alpine recreational utility system, including potable water, waste water management, power distribution and snow making.
* Alplan Consulting Ltd. Box 846 LILLOOET, British Columbia V0K 1V0 Phone: (604)256-7762 President & Senior Planner: Jim Norie	Consultants - Specialists in ski area planning, market research, land use planning (general) and management consulting.
* Arcop Thom 131 Water Street, Suite 208 VANCOUVER, British Columbia V68 4M3 Phone: (604)687-5796 W. Paul Hughes	Consultants - Recreation planners and Architects.
Cal-Eco Community and Recreation Planners Ltd. 621 Alexander Crescent, N.W. CALGARY, Alberta T2M 4B4 Phone: (403)282-2391 President: Clive B. Callaway	Planning for leisure, recreation and tourism. Specializing in concept and master planning for resorts and recreation areas. Impact assessment. Feasibility and market studies.
* Casey & O'Neill Suite 550 Sunlife Plaza 1100 Melville Street Vancouver, British Columbia V6E 4A6 Phone: (604)687-5792 Telex: 04-55536 (Corhart) President: John J. Casey	Barristers and Solicitors specializing in ski safety legislation.
* Chris Stethem Consulting Ltd. Box 8, 5 Whistler Centre WHISTLER, British Columbia VON 1B0 Phone: (604) 932-3871 President: Chris Stethem (604)932-3788 (res)	Avalanche safety specialists; general mountain safety; climate studies; technical witness.

Name	Service
Design Workshop Inc. 710 E. Durant ASPEN, Colorado 81611 USA Phone: (303)925-8354 President: Don Ensign	A land planning and landscape architectural firm specializing in mountain resort development.
* Ecosign Mountain Recreation Planners Ltd. Box 63 WHISTLER, British Columbia VON 1B0 Phone: (604)932-5976 President: Paul E. Mathews	Planners of year-round resorts, parks and associated residence developments. Mountain and Village Master Planning new and existing areas. Site Cap. and Feasibility Studies, Environmental Analysis and Impact. Market Economic Analysis, Financial Planning, Computer Planning Services.
* Ernst & Whinney Suite 3300 Park Place 666 Burrard Street VANCOUVER, British Columbia V6C 3A1 Phone: (604)683-3311 Partner: David A. Hughes Manager: Brian J. Wills	Certified management consultants and chartered accountants providing a full range of consulting, financial and business services to the ski and tourism industries. Offices across Canada and around the world.
* Golder Associates (Western Canada) Ltd. 224 West 8th Avenue VANCOUVER, British Columbia V5Y 1N4 Phone: (604)879-9266 Senior Hydrogeologist: Rick Guiton	Consulting services in soils, ground water and drainage.
* Group Delta #201, 239 - 10th Avenue, S.E. CALGARY, Alberta T2G 0V9 Phone: (403)266-0880 Vice President: Mike Bower	Planners, Engineer - Financial planning and feasibility studies. Appraisals, Utilities, Lifts and Snowmaking, Ski area sports and recreation facilities.
* Halcrow Engineering Consultants Ltd. 1520 Pemberton Avenue North Vancouver, British Columbia V7P 2S2 Phone: (604)988-6141 W. W. Johnson, P.Eng.	Engineering Consultants experienced in ski area design including lifts, lodges, layouts, water and waste.

Name	Service
* Hardy Associates (1978) Ltd. 9405 - 31 Avenue EDMONTON, Alberta T6K 4W8 Phone: (403)438-3779 P. Fok Calgary Branch 219 - 18th Street, S.E. CALGARY, Alberta T2E 6J5 Phone: (403)248-4331 W. A. Slusarchuk	Consulting services in non-destructive testing of lift equipment, failure investigation, slope stability assessment, foundation design, water supply, environmental planning, drainage and erosion control.
* International Ski Area Consultants Ltd. #203, 1990 - 152 Street SURREY, British Columbia V4A 4N6 Phone: (604)536-5080 General Manager (Canada): Doug Holmes	Consultants - ski resort brokerage appraisals, site evaluations, resort planning and operations, special project research, marketing and public relations.
* John G. Ogilvy Consulting Engineer Ltd. Box 352 JASPER, Alberta T0E 1E0 Pnone: (403)852-3759 President: John G. Ogilvy	Structural and civil engineering, ski area layout, lifts and services.
* Kem Kinetic Energy Management Ltd. 911 - 46 Avenue, S.E. CALGARY, Alberta T2G 2A5 Phone: (403)287-2610 President: Nicholas Perrin (403)271-9332 (res)	Consulting, audit and installation of energy-utility management system ranging from air sealing to micro-processor system control.
Mercon Engineering Ltd. Suite #202, 1601 Westmount Road, N.W. CALGARY, Alberta T2N 3M2 Phone: (403)283-5592 President: Peter Mulyk	Consulting engineers specializing in work related to municipal land development and planning environmental and civil engineering projects.
* Organization Explorations Incoporated 5597 Lee Drive EVERGREEN, CO 80439 Phone: (303)674-2020 President: John Mullen	Management, Organization, Human Resource and Employee Relations consulting and training to the ski industry.

Name	Service
* R-DAC Group Box 2709 INVERMERE, British Columbia Phone: (604)342-3547	Consultants - media services.
* Sno-Engineering Inc. Box 11535 ASPEN, Colorado 81611 USA Phone: (303)925-6615 Vice President Planning: William G. Kane	Consultants specializing in recreation and resort development.
U.M.A. Engineering Ltd. Connolly Facility Consultant 2540 Kensington Road, N.W. CALGARY, Alberta T2N 3S3 Phone: (403)283-4961 General Manager: G. W. Harrison	Overall team approach to planning and civil engineering services for winter recreation and facilities.

NOTE: For information only, listings do not imply recommendation or approval by Alberta Recreation and Parks.

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* SOURCE: CWSAA 1984-85 Membership List.

APPENDIX "E"

Wind Chill Factors and Tables

Source: Atmospheric Environment Service, Environment Canada.

Nearly everyone is aware of how much colder it feels outdoors on a windy day as compared to when there is no wind, particularly in the winter. This apparent "coldness" is due to the more rapid cooling effect produced by the wind to made it feel colder than it really is. The combined effect of wind and low temperatures is experienced by most Canadians in just about every part of Canada. The effect can produce serious and often dangerous conditions.

Wind Chill Factor as described in this pamphlet is a measure of the combined chilling effect of wind and temperature. Although the actual calculation of the factor is based upon how fast water will cool with the combination of low temperature and wind, it has been found to be equally applicable to the cooling effect experienced by the human body and by an inanimate object.

The advantage of Wind Chill Factor over other measurements methods is that it represents a real rate of cooling, in other words how fast an object cools. For example, the combination of a specific temperature and wind speed can be related to how fast exposed flesh will freeze. On the average the value of 1625 watts per square meter presents the condition where exposed flesh will freeze. It also gives an indication of how difficult it is to maintain an object, for example a house, at a given temperature.

In the past it has been common practice to use an equivalent temperature (wind chill temperature) to relate wind and temperature. Unfortunately the values obtained by this method often have been beyond the experience of most people. For example, -50°C occurs in relatively unpopulated areas of Canada. More importantly the equivalent temperature still does not relate to the combined effect of wind and temperature on the human body. It also is too easily confused with the actual temperature.

Examples of the Effect of Wind Chill Factor

1. Water will freeze more quickly at high wind chill factors than at low.

2. The ability of an engine block heater to keep a car engine warm decreases with increasing wind chill factor.

3. The length of time a car can be left turned off before reaching the surrounding air temperture decreases with increasing wind chill factor.

4. With increasing wind chill factor there is an increase in the fuel needed to heat buildings, particularly when the building is poorly insulated.

5. Exposed flesh freezes more rapidly with higher wind chill factors.

Examples of Wind Chill Factor

Wind Chill Factor	Comments
700	Conditions considered comfortable when dressed for skiing
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

The unit of Wind Chill Factor used in this pamphlet are watts per square meter.

Acknowledgement

Saskatchewan Research Council has assisted in providing information contained in this pamphlet.

Refer to diagram on opposite page for graph to calculate Wind Chill Factor.

WIND CHILL TABLE IN DEGREES CELSIUS

Temperature (C°)	2	-1	-4	-7	-9	-12	-15	-18	-21	-23	-26
Wind (m.p.h.)											
Calm	2	-1	-4	-7	-9	-12	-15	-18	-21	-23	-26
5	1	-3	-6	-9	-11	-14	-17	-21	-24	-26	-29
10	-6	-9	-13	-17	-19	-23	-26	-30	-33	-35	-39
15	-9	-12	-17	-21	-24	-28	-32	-36	-40	-43	-46
20	-11	-16	-20	-23	-27	-31	-36	-40	-43	-47	-51
25	-14	-18	-22	-26	-30	-34	-38	-43	-47	-50	-55
30	-15	-19	-24	-28	-32	-36	-41	-45	-49	-53	-57
35	-16	-20	-25	-29	-33	-37	-42	-47	-51	-55	-58
40	-17	-20	-26	-30	-34	-38	-43	-48	-52	-56	-60
45	-17	-21	-27	-31	-35	-39	-43	-48	-53	-57	-61
50	-18	-22	-27	-31	-35	-39	-44	-49	-53	-57	-62

Exposed Flesh Freezes

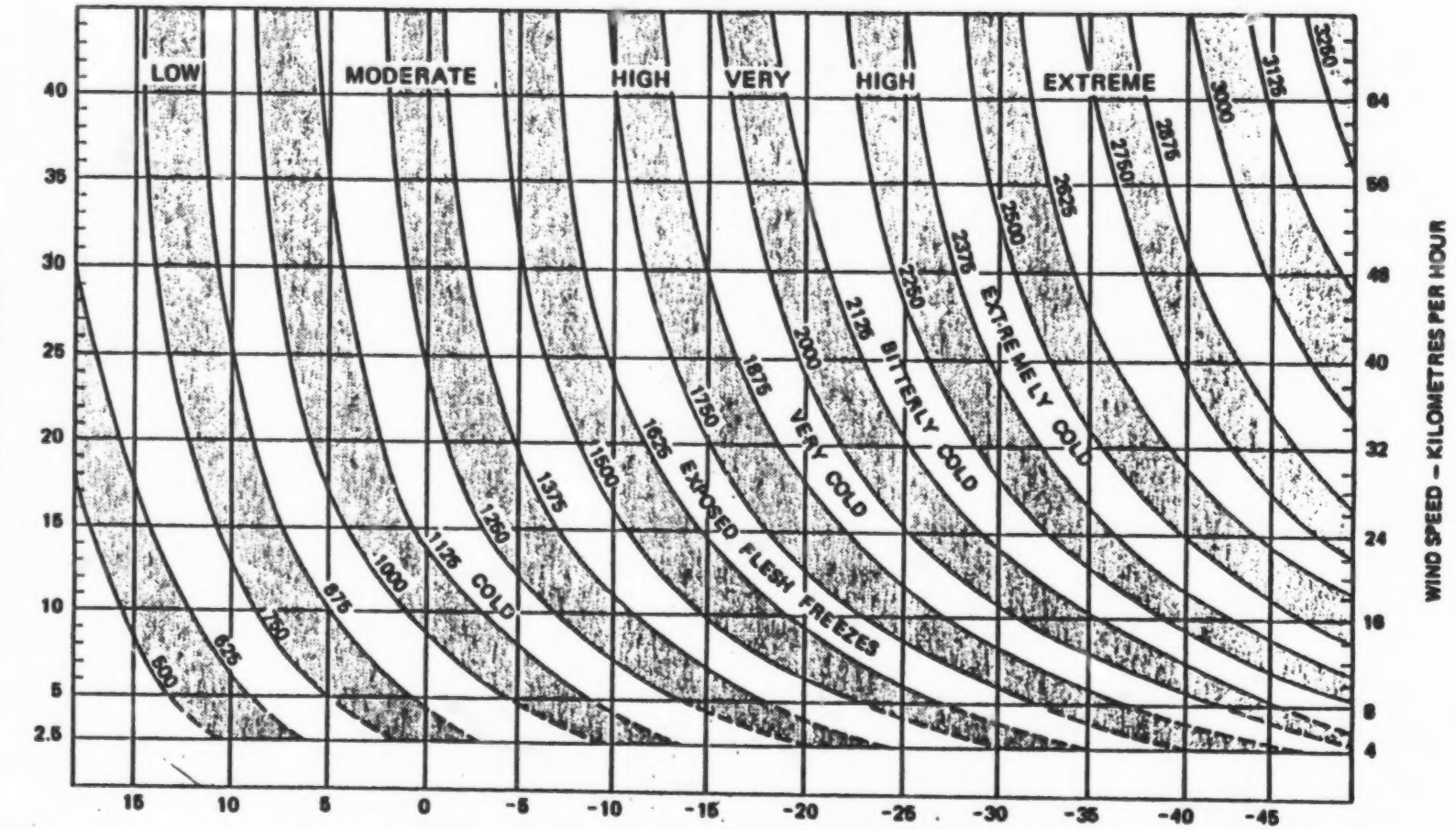
Wind speeds greater than 40 mph have little additional chilling effect.

Table shows equivalent low temperatures from cold plus wind.

(EQUIVALENT TEMPERATURES) - Equivalent in cooling power on exposed flesh under calm conditions.

Wind chill equivalents to various celsius temperatures and wind speeds

WIND CHILL COOLING RATES
(Watts Per Square Meter)



To determine the wind chill factor, follow the temperature up and the wind speed across until the two lines intersect. The value of the wind chill factor can be interpolated using the labeled wind chill factor curves.

For example, at -10°C with a wind speed of 20 miles per hour the point of intersection lies between 1500 and 1625, or approximately 1570.

It is not recommended that wind chill factors be calculated for wind speeds below 5 miles an hour, since it is difficult to determine wind chill factors at these wind speeds and because other factors such as relative humidity become important.

APPENDIX "F"

Required Facility Areas

Zone I
(Day Use and Prime Support)
(Terrain Limitations - 0%-30%)

ACTIVITY OR ITEM	Requirement Per SAOT Unit *		Requirement Per PAOT Unit **	
	m^2	f^2	m^2	f^2
Parking and Roads	--	--	13.46	145.0
Congregation and Day Lodge	4.64	50.0	--	--
Sundecks	--	--	0.186	2.0
Cafeteria	--	--	0.371	4.0
Brown Bag Room	0.139	1.5	--	--
Commercial area	--	--	0.929	10.0
Ski Racks	0.093	1.0	--	--
Administration	0.046	0.5	--	--
F.S. Admin., VIS, Housing	0.028	0.3	--	--
Ticket Sales	0.0056	0.06	--	--
Warming Space	0.046	0.5	--	--
Nursery	--	--	0.0046	0.05
Chapel	--	--	0.019	0.2
Ski Patrol	0.028	0.3	--	--
First Aid	0.056	0.6	--	--
Ski School (Gathering Area, Lockers)	0.037	0.4	--	--
Ski Shop	--	--	0.186	2.0
Bierstub	--	--	0.297	3.2
Ice Skating Rink	--	--	0.232	2.5
Public Toilets	--	--	0.037	0.4
Change Room and Lockers	0.019	0.2	--	--
Snow Play	--	--	6.964	75.0
Snowmobile Rental (Storage, shops, parking)	--	--	0.176	1.9
Sewage Disposal	--	--	3.714	40.0
Employee Housing	--	--	0.929	10.0
Open Space	--	--	37.143	400.0

* Skier at one time.
** People at one time.

Zone II
(Public Overnight)
(Terrain Limitations - 0%-30%)

ACTIVITY OR ITEM	Requirement Per SAOT Unit		Requirement Per PAOT Unit	
	m^2	f^2	m^2	f^2
Motel	--	--	18.571	200.0
Motel Parking	--	--	13.464	145.0
Hotel	--	--	18.571	200.0
Hotel Parking	--	--	13.464	145.0
Conference Rooms	--	--	0.743	8.0
Restaurant	--	--	0.557	6.0
Lounge	--	--	0.186	2.0
Indoor Recreation	--	--	0.046	0.5
Sauna	--	--	0.139	1.5
Swimming Pool	--	--	0.464	5.0
Sewage Disposal	--	--	3.714	40.0
Open Space	--	--	75.864	817.0
Summer Use				
Stables (1% of overnight capacity)	11.143 ($120 f^2$) per person			
Golf Course (5% of overnight capacity)	68.8 hectares (170 acres) per person			
Tennis Courts (5% of overnight capacity)	668.6 ($7,200 f^2$) per 4 persons			

Zone III
(Exclusive Overnight - Private and Restricted Public))
(Terrain Limitations - 0%-40%)

ACTIVITY OR ITEM	Requirement Per SAOT Unit		Requirement Per PAOT Unit	
	m^2	f^2	m^2	f^2
Condominium	--	--	25.536	275.0
Condominium with Parking	--	--	12.536	135.0
Swimming Pool	--	--	0.929	10.0
Residences	--	--	59.429	640.0
Sewage Disposal	--	--	3.714	40.0
Ski Club	--	--	6.964	75.0
Open Space	--	--	108.643	1170.0

Zone IV

ACTIVITY OR ITEM	Requirement Per SAOT Unit		Requirement Per PAOT Unit	
	m^2	f^2	m^2	f^2
Maintenance Area	1.021	11.0	--	--
General Storage	--	--	0.028	0.3
Power Equipment	--	--	0.0037	0.04
Telephone Equipment	--	--	0.0028	0.03
Open Space	--	--	1.114	12.0

SOURCE: 1976 Edition "Ski Area Planning".

APPENDIX "G"

Elevator and Fixed Conveyances Act
Chapter E-7

GOVERNMENT OF THE PROVINCE OF ALBERTA

ELEVATOR AND FIXED CONVEYANCES ACT

CHAPTER E-7
REVISED STATUTES
OF ALBERTA
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ELEVATOR AND FIXED CONVEYANCES ACT

CHAPTER E-7

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of Alberta, enacts as follows:

Definitions

1 In this Act,

(a) "fixed conveyance" means a fixed system or device for conveyance to which this Act applies;

(b) "inspector" means an inspector appointed under section 3, and includes the Chief Inspector;

(c) "Minister" means the member of the Executive Council charged by the Lieutenant Governor in Council with the administration of this Act;

(d) "owner" includes a lessee of a fixed conveyance.

RSA 1970 c121 s2

Application of Act

2(1) This Act applies to passenger elevators, freight elevators, dumbwaiters, escalators, inclined passenger lifts, belt lifts, aerial tramways, chairlifts, ski tows, rope tows, mechanized parking garages, speedwalks and speedramps.

(2) The Lieutenant Governor in Council may designate any fixed conveyor system, whether vertical, inclined or horizontal, to be a fixed conveyance to which this Act applies.

RSA 1970 c121 s3

Inspectors

3(1) In accordance with the *Public Service Act* there may be appointed as many inspectors as are considered necessary for the purposes of this Act, one of whom shall be designated as Chief Inspector.

(2) The Chief Inspector is responsible for the general supervision and direction of the other inspectors and carrying out this Act and the regulations.

RSA 1970 c121 s4

Powers of Inspector

4(1) An inspector may, in the execution of his duties under this Act and for enforcing this Act and the regulations,

(a) gain access to and inspect at all reasonable times by day or night any fixed conveyance,

(b) enter, pass over or through any land, building or premises for the purpose of this Act,

(c) demand the production of any register, certificate, plan or document pertaining to any fixed conveyance and may examine and copy it,

(d) make any examination and inquiry that may be necessary to ascertain whether this Act and the regulations are being complied with,

(e) for the purpose of any investigation, inquiry or examination made by him under the authority of this Act, administer an oath and summon any person to give evidence and produce plans, specifications, files and records, and

(f) exercise any other powers necessary for carrying out this Act and the regulations.

(2) All plans, specifications, files and records produced and inspected pursuant to subsection (1)(c) or (e) shall be treated by the inspector as confidential, except for the purpose of this Act.

(3) The owner of a fixed conveyance and his agents and servants shall furnish any necessary assistance required by an inspector for the exercise of his duties under this Act and the regulations.

RSA 1970 c121 s5

Private residences

5 If a fixed conveyance is installed in a private residence and an inspector has inspected the completed installation and found it to be in accordance with this Act and the regulations, he shall give his approval of it in writing and thereafter this Act does not apply to that fixed conveyance, except when

(a) the owner or occupier of the residence requests an inspection,

(b) any alteration is proposed to be made to the conveyance, or

(c) the Minister orders an inquiry under section 14.

RSA 1970 c121 s5(4)

Certificate of appointment of inspector

6 An inspector shall be furnished with a certificate of his appointment under the hand of the Minister and shall, if required, produce his certificate on applying for admission to any premises.

RSA 1970 c121 s6

Persons accompanying inspector

7 When he considers it necessary, an inspector may take with him into any premises an engineer or other specialist.

RSA 1970 c121 s7

Warner of responsibility

8 An inspector or a person lawfully accompanying an inspector is

not required to sign or give any release or waiver of responsibility before entering any place pursuant to this Act and any such release is void.

RSA 1970 c121 s8

Liability of inspector

9 While acting pursuant to this Act or the regulations, an inspector or a person lawfully accompanying an inspector is not liable for any injury, loss or damage occasioned while he is so acting.

RSA 1970 c121 s9

Approval of fixed conveyance

10(1) The Chief Inspector may, subject to the regulations, approve or refuse to approve different types of fixed conveyances and any component parts thereof.

(2) When any type of fixed conveyance or component part submitted for approval requires special examination, the person making the submission may be required to supply all the necessary materials, parts, plans and specifications and to pay any fees fixed by regulations.

(3) No person shall

(a) install a fixed conveyance, or

(b) install in or attach to a fixed conveyance any component part,

of a type that the Chief Inspector has refused to approve.

RSA 1970 c121 s10

Direction for remedial action

11(1) When an inspector notes a condition that contravenes a regulation or is otherwise inconsistent with good operating practices relating to a fixed conveyance, he may bring the condition to the attention of the owner or his agent, who shall take whatever remedial action is required by the inspector within the specified time.

(2) When an inspector notes an unsafe condition that in his opinion presents an immediate hazard to persons using a fixed conveyance, the inspector may direct that the conveyance be taken out of service until the hazard is removed and the owner or his agent shall comply with the direction of the inspector.

RSA 1970 c121 s11

Appeal

12 A person affected by a decision of an inspector may appeal to the Minister.

RSA 1970 c121 s12

Notice of accident

13 An owner of a fixed conveyance or his agent shall

(a) notify an inspector as soon as possible after the happening of any accident involving the fixed conveyance that results in death or serious injury or damage to equipment, and

(b) if requested by an inspector, submit as early as possible a

full report in writing of any accident involving the fixed conveyance that results in death or injury or damage to equipment.

RSA 1970 c121 s13

Investigation of accident

14(1) Any accident involving a fixed conveyance that results in death, injury or damage to equipment may be investigated by an inspector.

(2) The Minister may cause an inquiry to be held into any accident involving a fixed conveyance that results in death or injury or damage to equipment.

RSA 1970 c121 s14

Protection of evidence

15(1) Until permission is received from an inspector no unauthorized person shall

(a) interfere with the scene of an accident involving a fixed conveyance except to prevent further damage or to remove injured or deceased persons or hazards, or

(b) remove or tamper with any safety device, guard or other protective equipment.

(2) For the purposes of investigation and inquiry and to prevent it being lost or misplaced, an inspector may remove from the scene of an accident any article, part or thing that in his opinion may have caused or contributed in any way to the accident.

(3) The powers given to an inspector by this section shall not be construed as derogating from or interfering with the powers and duties of peace officers or of medical examiners under the *Fatality Inquiries Act*.

RSA 1970 c121 s15

Inquest

16 The Chief Inspector has a right to be represented at a public inquiry under the *Fatality Inquiries Act* into a death that may involve a fixed conveyance and he or his representative may examine any witness.

RSA 1970 c121 s16

Approval of proposed alteration

17(1) Before erecting or altering a fixed conveyance the owner or his agent shall submit all relevant plans, blueprints, drawings and specifications required by an inspector and no person shall

(a) construct or alter the conveyance, or

(b) begin the construction or alteration,

until the plans, blueprints, drawings and specifications have been certified as approved pursuant to subsection (2).

(2) If the plans, blueprints, drawings and specifications provide for the fulfilment of the requirements of this Act and the regulations, the Chief Inspector, or an inspector authorized by him, shall certify

the plans, blueprints, drawings and specifications as approved.

RSA 1970 c121 s17

Posting of certificate or licence

18 A certificate or licence issued pursuant to this Act or the regulations shall be posted by the owner or his agent as directed by an inspector.

RSA 1970 c121 s18

Posting of notice

19 The Minister may approve the issuing of notices or bulletins dealing with the use of fixed conveyances and the owner or his agent shall post the notices or bulletins as directed by an inspector.

RSA 1970 c121 s19

Removal or defacing of bulletins prohibited

20 No unauthorized person shall remove, alter or deface any certificate, licence, notice or bulletin posted pursuant to this Act or the regulations.

RSA 1970 c121 s20

Regulations

21 The Lieutenant Governor in Council may make regulations

(a) with respect to the construction, maintenance and use of any type or class of fixed conveyance;

(b) prescribing the nature and frequency of inspections to be made of fixed conveyances or any type or class of fixed conveyances;

(c) prescribing the requirements for or the conditions under which approval may be given pursuant to sections 10 and 17;

(d) prohibiting or restricting the use of any type or class of fixed conveyance, either generally or for particular purposes;

(e) respecting the issue of certificates and licences, including the conditions under which they may be granted, suspended, revoked or transferred;

(f) prescribing the fees payable in respect of any approval of plans, blueprints, drawings and specifications, or otherwise, in respect of inspections and in respect of the issue of certificates and licences, and the persons by whom the fees are to be paid;

(g) respecting any other matters that may be necessary for carrying out the intent of this Act, including the adoption of all or part of any safety code, order, regulation or standard.

RSA 1970 c121 s21

Offence and penalty

22(1) A person who contravenes

(a) this Act or the regulations, or

(b) an order or direction of an inspector given pursuant to this Act or the regulations,

is guilty of an offence and liable to a fine of not more than $500 and in default of payment to imprisonment for a term not exceeding 12 months.

(2) A prosecution under this section may be commenced within 2 years of the commission of the alleged offence, but not afterward.

RSA 1970 c121 s22

ALBERTA REGULATION 338/62

THE ELEVATOR AND FIXED CONVEYANCES ACT

REGULATIONS GOVERNING THE CONSTRUCTION, OPERATION, MAINTENANCE AND INSPECTION OF INCLINED PASSENGER LIFTS

(O.C. 907/62)

(Filed June 15, 1962)

The Lieutenant Governor in Council, upon the recommendation of the Honourable the Minister of Labour, pursuant to section 21 of The Elevator and Fixed Conveyances Act, is pleased to establish Regulations Governing the Construction, Operation, Maintenance and Inspection of Inclined Passenger Lifts in accordance with the Schedule hereto.

SCHEDULE

Scope

1. These regulations apply to the construction, operation, maintenance and inspection of all inclined passenger lifts for public, private, or industrial use, installed in the Province of Alberta after the date these regulations come into force.

Definitions

2. (1) In these regulations an "inclined passenger lift" means a device constructed and operated for transporting persons from one elevation to another and consisting essentially of a level car or platform travelling on guide rails in an inclined plane.

(2) Devices installed indoors on stairways and utilitizing chairs for carrying passengers are not considered as being inclined passenger lifts insofar as these regulations are concerned.

(3) The term "enforcing authority" means The Elevator and Fixed Conveyances Act Branch, Department of Labour.

Workmanship

3. (1) In the installation of all work governed by these regulations, special attention shall be paid to the mechanical execution of the work.

(2) Work badly arranged or poorly executed will not be approved.

Approval of Plans and Specifications

4. (1) Before commencing construction of any inclined passenger lift, the owner shall submit complete plans and specifications to the enforcing authority for approval.

(2) Plans and specifications covering the installation of an inclined passenger lift shall be endorsed by a professional engineer before approval by the enforcing authority will be considered.

Runway Enclosures

5. (1) Runways of inclined passenger lifts shall be enclosed along each side except at landing areas with wire fencing of the chain-link type.

(2) Runway enclosures shall extend to a height of at least 6 feet above the grade level or the highest working level adjacent to the runway or from the treads of adjoining stairways or platforms.

(3) Wire used for runway enclosures shall not be less than the number 9 A.W.G. and open work in the enclosure shall reject a ball 2 inches in diameter.

(4) An emergency exit shall be provided in the runway enclosure of an inclined passenger lift.

(5) Emergency doors shall be installed in the side of the runway enclosure adjacent to the entrance in the car enclosure and shall be fitted with locks that will permit the doors to be opened from inside without a key.

Landing Enclosures

6. (1) The landing area of an inclined passenger lift adjacent to the runway shall be enclosed with substantial masonry, concrete, metal, wood, safety glass or screen walls.

(2) Landing enclosure walls shall be a minimum of 6 feet in height and any open work in the walls shall reject a ball one inch in diameter.

Enclosure Clearances

7. (1) No section of the runway enclosure shall be less than 3 feet from the running line of the car.

(2) There shall be a clearance of not less than ¾ inch between the sides of the car and the landing area enclosure.

(3) The minimum clearance between the car platform and the landing sills shall be ⅜ inch, and the maximum permissible clearance shall be 1¼ inches.

Machine Rooms

8. (1) Safe and convenient access shall be provided to machine rooms of inclined passenger lifts from outside the runway enclosure.

(2) Machine rooms shall be substantially constructed to protect equipment from the weather and shall be secured against unauthorized access.

(3) A minimum of 7 feet head room shall be maintained in machine rooms.

(4) Machine room illumination shall be not less than 10 foot candles at floor level.

(5) Light switches and motor disconnect switches shall be located as close as possible to the lock jamb side of machine room access doors.

(6) Machine enclosures shall provide a minimum of 12 inches horizontal or vertical clearance as necessary to give access to such parts of the machinery as require Maintenance.

Machine Supports and Factors of Safety

9. (1) Machinery and sheaves shall be so supported and held as to effectually prevent any part becoming displaced.

(2) The factor of safety for machine beams and their immediate supporting beams shall be as follows:

(a) for steel—5.

(b) Reinforced concrete—7.

Car Clearances

10. (1) When the car is at its top landing the clear distance between the front of the car and the corresponding point of any obstruction at the upper end of the runway shall be at least the sum of the following:

(a) The clearance between the counterweight buffer and its striking block which shall be at least 6 inches.

(b) The stroke of the buffer used.

(c) 2 feet.

(2) When the car is resting on its fully compressed buffer there shall be a minimum clear distance of 2 feet between the rear of the car and the lower end of the runway enclosure.

Counterweight Clearances

11. When the car is at its lower landing the clear distance between the upper end of the counterweight and the corresponding point of any obstruction at the upper end of the runway shall be at least the sum of the following:

(a) The clear distance between the top of the car buffer and its striking block which shall be at least 3 inches.

(b) The stroke of the car buffer used.

(c) 6 inches.

Landing Doors or Gates

12. (1) At each landing area of an inclined passenger lift the opening providing access to the car shall be protected by a door or gate.

(2) Landing doors or gates shall be at least 6 feet in height and shall be either solid or of open-work construction rejecting a ball one inch in diameter.

(3) Landing doors or gates shall be equipped with a locking device which will prevent the opening of a door or gate if the car is not within the landing zone, and the starting of the car if a door or gate is not closed.

(4) The maximum distance between the runway side of the landing door and the runway side of the landing sill shall not exceed 4 inches.

Landing Sills

13. (1) Landing sills for inclined passenger lifts shall be constructed and maintained so that persons will not readily slip thereon and shall be flush with adjacent floor surfaces.

Guide Rails

14. (1) Guide rails for inclined passenger lifts shall be rigidly fixed and supported in proper alignment to withstand the loads likely to be imposed upon them by the car or counterweight.

(2) Guide rails shall be constructed of metal.

Car Enclosure

15. (1) Inclined passenger lift cars shall have metal frames and metal outside frames of platforms.

(2) Cars shall be enclosed on the sides with solid or perforated materials to a height of 6 feet, and if perforated materials be used, openings shall reject a ball one inch in diameter.

(3) Car enclosures shall be metal, wood or other suitable material capable of safely withstanding any load or pressure to which they may be subjected.

(4) Each entrance to an inclined passenger lift car shall be provided with a door or gate covering the full width and height of the opening.

(5) Car doors or gates may be solid or have openings that will reject a ball one inch in diameter.

(6) Each car door or gate shall be of the sliding type or the swing type opening into the car.

(7) Inclined passenger lift car doors or gates shall be equipped with a contact that shall prevent operation of the car unless the door or gate is within 2 inches of being fully closed.

(8) Cars of inclined passenger lifts shall be provided with a device that will prevent the car from leaving the guide rails.

(9) In addition to a capacity plate that shall be posted in the car of every inclined passenger lift, a data plate specifying the following shall also be attached to the car:

(a) Manufacturer.

(b) Speed.

(c) Number and size of ropes.

Safeties

16. (1) Every inclined passenger lift shall have a car safety that shall be applied automatically when a governor driven by the movement of the car exceeds a predetermined maximum speed.

(2) Car safeties shall be capable of stopping and sustaining the car with contract load.

Car Speed Governors

17. (1) The car speed governor shall be set to cause application of the safety at a speed not more than 40% and not less than 15% above the contract speed of the car.

(2) Car speed governors shall be equipped with a data plate specifying:

(a) The manufacturer, and

(b) The rated tripping speed.

(3) On inclined passenger lifts every car safety shall be provided with a switch operated by the car safety mechanism when the safety is applied.

(4) The car safety mechanism switch shall, when operated, remove power from the driving-machine motor and brake before or at the time of application of the safety.

(5) The car safety mechanism switch shall be designed to prevent automatic reset on release of safeties.

Machines

18. (1) Drums and sheaves shall be of cast iron or steel and shall have finished grooves which may be faced with material, other than iron or steel, having sufficient traction.

(2) The radius of U grooves shall be approximately 1/32 inch larger than the radius of the ropes.

(3) Sheaves or drums for hoisting ropes shall be at least 40 times the diameter of the ropes used.

(4) The factors of safety based on static loads to be used in the design of inclined lift hoisting machines shall be at least:

(a) Wrought iron or wrought steel—8.

(b) Cast iron, cast steel or other materials—10.

(5) Set-screw fastenings shall not be used instead of keys or pins except when the connection is not subject to torque.

(6) The use of friction gearing or clutch mechanisms for connecting drums or sheaves to the main driving gear is forbidden.

(7) The installation of belt or chain-driven machines to drive an inclined passenger lift is forbidden.

(8) The use of worm gearing with cast iron teeth or the use of cast iron pinion of spur gearing is prohibited.

(9) Inclined passenger lift machines shall be equipped with electrically-released brakes capable of stopping and holding the car with its rated load.

(10) Brakes shall be applied automatically by springs or gravity when the operating device is at the "stop" position.

(11) Brakes shall not be released until power has been applied to the motor.

Terminal Stopping and Safety Devices

19. (1) Inclined passenger lifts shall be provided with upper and lower normal terminal stopping devices arranged to stop the car automatically within the top and bottom over-travel limits, independently of the operating devices, the final terminal stopping device and the buffers.

(2) Inclined passenger lifts shall be provided with upper and lower final terminal stopping devices, arranged to stop the car and counterweight automatically from contract speed within the top clearance and the bottom overtravel, independently of the operating device, but with the buffers operative.

(3) Final limit switches shall be set to operate with the car as close to the terminal landing as practical, without interferring with normal operation and shall be set to open on contact with the buffer.

(4) Final limit switches shall be located in the runway and be operated by the movement of the car.

(5) The final terminal stopping device shall act to prevent movement of the car in both directions.

(6) The normal and final terminal stopping devices shall not control the same switches on the controller unless two or more separate and independent switches are provided, two of which, shall be closed to complete the motor and brake circuit in each direction of travel.

(7) When 2-phase or 3-phase alternating current is used to operate the inclined passenger lift, the controller switches referred to in subsection (6) shall be of the multipole type.

(8) Normal and final terminal stopping switches shall be of the enclosed type.

(9) The cams for operating the terminal stopping switches shall be of metal and shall be so located and of sufficient length to maintain the switches in the "open" position when the car has reached its maximum travel at either end of the runway.

(10) Inclined passenger lifts utilizing machines of the winding-drum type shall have, in addition to final limit switches located in the runway and operated by the movement of the car, final terminal stopping switches on the machine.

(11) Chain, rope or belt-driven machine terminal stopping devices shall not be used for inclined passenger lifts having winding-drum machines.

(12) Inclined passenger lifts having winding-drum machines driven by 2-phase or 3-phase a.c. motors shall have the mainline circuit to the motor and the brake directly opened either by

(a) Contacts in the machine stop-motion switch, or

(b) Runway limit switches.

(13) The runway limit switches referred to in subsection (12-b) may be operated either by a cam attached to the car or, the up-travel limit switch may be operated by a cam attached to the car and the down-travel limit switch may be operated by a cam attached to the counterweight; and the opening of the contacts shall take place before or coincident with the opening of the final terminal stopping device and shall prevent movement of the machine in either direction.

(14) Subsection (12) does not apply to inclined passenger lift machines with a.c. motors and d.c. brakes and d.c. mainline or potential switches controlled by final limit switches located in the runway.

(15) Inclined passenger lifts having winding-drum machines shall be provided with a slack cable device which will cut off the power and stop the machine if the car is obstructed in its descent.

(16) Slack cable switches shall be so constructed that they will not automatically reset when the slack in the cable is removed.

(17) Electric slack cable switches shall be of the enclosed type.

Operation and Control

20. (1) The controls of an inclined passenger lift shall be so constructed that

(a) It is impossible to start the car unless all runway doors are closed and in a position to be locked when the car leaves a landing, and

(b) After car has started for a given landing, it is impossible for an impulse to be given from any landing to reverse direction of the car until it has reached the destination corresponding to the first impulse.

(2) Where metal-to-metal contacts, gravity or spring opened, or a combination of the two are used on controller switches for stopping inclined passenger lift machines, at least two independent breaks separately operated shall be provided.

(3) Breaking the circuit to stop an inclined passenger lift at the terminals shall not be solely dependent on the operation of springs in tension or the completion of another electric circuit and if springs be used, they shall be in compression.

(4) The interruption of the electric circuit shall prevent the movement of the car.

(5) The use of control systems that depend on the completion or maintenance of an electric circuit for the following is forbidden:

(a) The interruption of the power and for the application of electro-mechanical brakes at the terminals.

(b) The operation of safeties, or

(c) The closing of a contactor by an emergency stop-button.

(6) Every inclined passenger lift shall be provided with a stopping device which can be operated from the car, that when operated, will cut off power to the driving machine and set the brake.

Limits of Speed

21. Maximum speed for inclined passenger lifts shall not exceed 100 feet per minute.

Ropes

22. (1) The factor of safety based on static loads for car and counterweight ropes shall be at least 7:1.

(2) The minimum number of hoisting ropes shall be as follows:

(a) Traction machines—3.

(b) Winding-drum machines—2.

(3) A hoisting rope less than ½ inch diameter shall not be used.

(4) The repair or lengthening of car or counterweight ropes by splicing is forbidden.

(5) All ropes anchored to a winding drum shall have not less than 1½ turns of rope on the drum when the car or counterweight has reached the extreme limit of its overtravel.

(6) When the ropes are fastened inside a winding drum, they shall pass around the shaft before being fastened, or be fastened to a clevice passing around the shaft in cases where the shaft revolves in an opposite direction to the drum and the ends of such ropes shall be secured by clips or by individual tapered babbitted sockets.

Fastening Car and Counterweight Ends of Ropes

23. (1) The car and counterweight ends of ropes shall be fastened by individual tapered babbitted sockets or by clip fastenings.

(2) If socketed rope fastenings be used, adjustable shackle rods shall be provided to attach ropes to cars and counterweights in such a manner that all portions of the rope except the portion in the socket shall be readily visible.

(3) Clip fastenings shall conform to the following:

(a) The clip used shall consist of a U bolt with nuts on both ends of the "U" and a base grooved to suit the rope used.

(b) The U bolt shall be drop-forged.

(c) The base or saddle shall be or forged steel, cast steel or malleable iron.

(d) The clip shall be a close fit on the rope used.

(4) The minimum number of clips to be used on each rope end shall be:

(a) 3 clips for ropes not over ⅝ inch diameter.

(b) 4 clips for ropes not over ¾ inch diameter.

Rope Tags

24. (1) Every person installing a hoisting, counterweight, or governor rope shall provide a metal or plastic tag legibly showing the date of installation, the grade of material, diameter, ultimate strength and notice if rope is "preformed" or "non-preformed".

(2) The tag required under subsection (1) shall be attached to the rope at the car, counterweight or governor, as the case may be.

Buffers

25. (1) Spring buffers shall be provided for the car and counterweight at the lower end of the runway.

(2) Buffers shall be mounted on substantial supports and shall withstand without damage the impact of the fully loaded car or counterweight at contract speed.

Electrical Equipment

26. The installation of all electrical equipment used in connection with an inclined passenger lift shall comply with the requirements of the Canadian Standards Association Canadian Electrical Code, Part 1.

Inspections and Tests

27. (1) On completion of every new or altered inclined passenger lift installation, tests shall be made with contract load in the car under supervision of the enforcing authority, before the equipment is placed in regular service.

(2) In the tests required under subsection (1) brakes, limit switches, buffers, car safeties, speed governors, and all other safety devices shall be caused to function.

(3) Prior to placing any new or altered inclined passenger lift into regular service, a thorough examination of the entire installation shall be made by the enforcing authority to insure conformity with these regulations in all respects.

(4) Failure of any safety device to function properly under test, or non-compliance with any part of the governing regulations shall be cause to withhold clearance for operation until satisfactory repairs or alterations are effected.

(5) Every existing inclined passenger lift shall be inspected at least once each year by the enforcing authority, and repairs or tests deemed necessary by the Inspector shall be made as directed.

Maintenance

28. Owners of inclined passenger lifts shall be responsible for maintaining their equipment in safe-operating condition at all times.

29. When an Inspector discovers an unsafe condition in connection with an inclined passenger lift that is not specifically covered by these regulations, he shall issue an order requiring the owner to make such changes, improvements or repairs as may be necessary to remove hazards to persons or reduce the possibility of accidents and the owner shall comply with the order of the Inspector.

30. Alberta Regulation 267/59, is hereby rescinded.

31. These regulations become operative on and after the date of publication in the *Alberta Gazette*.

ALBERTA REGULATION 268/80

(Filed on September 3, 1980)

THE ELEVATORS AND FIXED CONVEYANCES ACT

(O.C. 854/80)

Approved and Ordered,
F. LYNCH-STAUNTON,
Lieutenant Governor.

Edmonton, September 3, 1980

Upon the recommendation of the Honourable the Minister of Labour, the Lieutenant Governor in Council, pursuant to section 21 of The Elevators and Fixed Conveyances Act,

(a) declares the National Standard of Canada for Passenger Ropeways, CSA — CAN 3-Z98-M78 to be in force subject to the variations set forth in the attached Appendix, and

(b) repeals Alberta Regulations 121/68 and 122/68.

PETER LOUGHEED (Chairman)

APPENDIX

THE ELEVATORS AND FIXED CONVEYANCES ACT

National Standard of Canada for Passenger Ropeways,
CSA — CAN 3-Z98-M78, Amendment Regulation

1 The National Standard of Canada for Passenger Ropeways, CSA — CAN 3-Z98-M78, is amended by this regulation.

2 Clause 2 "Definitions" is amended in Clause 2.1 by adding, before the definition "Approved", the following:

"Alberta Building Regulation" means The Alberta Uniform Building Standards Act and the regulation made under that Act;

"Alberta Electrical Regulation" means The Electrical Protection Act and the regulations made under that Act;

3 In the following provisions "C 22.1-1975, Canadian Electrical Code, Part 1" is struck out and "Alberta Electrical Regulation" is substituted wherever it occurs in those provisions:

Clause 1.5;
Clause 3.5.4.

4 In the following provisions "National Building Code of Canada, 1977" and "National Building Code" is struck out and "Alberta Building Regulation" is substituted wherever it occurs in those provisions:

Clause 1.5;
Clause 3.9.8;
Clause 3.18.4;
Clause 3.21.1;
Clause 8.7.1;
Clause 8.11.1;
Clause 8.17.2.1;
Clause 8.17.2.1;
Clause 8.18.1.2.

5 The Following is added immediately after section 3.7.1.1:

3.7.1.1A(1) Before erection or alteration of a passenger ropeway plans and specifications shall be submitted by the owner or his agent to the authority having jurisdiction.

(2) Plans and specifications covering an installation shall be endorsed by a professional engineer before the authority having jurisdiction will consider approval of them.

(3) If the plans and specifications provide for compliance with the requirements of this Standard the authority having jurisdiction shall certify the plans and specifications as having been approved.

(4) Where approval of plans and specifications has been refused no person shall install or alter a passenger ropeway until the plans or specifications have been revised to the satisfaction of the authority having jurisdiction.

3.7.1.1B Before the ropeway is placed in operation it shall be thoroughly inspected and tested by an inspector of the authority having jurisdiction or by a person or firm authorized by the authority having jurisdiction to confirm that it meets the requirements of the approved plans, and specifications in every respect.

3.7.1.1C No person shall operate or permit any passenger ropeway to be operated unless a certificate of inspection has been issued annually for it by the authority having jurisdiction.

ALBERTA REGULATION 269/80

(Filed on September 3, 1980)

THE REGULATIONS ACT

(O.C. 855/80)

Approved and Ordered,
F. LYNCH-STAUNTON,
Lieutenant Governor

Edmonton, September 3, 1980

Whereas the National Standard of Canada for Passenger Ropeways, CSA — CAN 3-Z98-M78 as adopted under section 21 of The Elevator and Fixed Conveyances Act,

(a) is available in printed form to all persons who are likely to be interested therein, and

(b) is of such length as to render publication thereof in The Alberta Gazette unnecessary or undesirable:

Therefore, upon the recommendation of the Honourable the Minister of Labour, the Lieutenant Governor in Council, pursuant to section 4(3) of The Regulations Act, dispenses with the publication of the National Standard of Canada for Passenger Ropeways, CSA — CAN 3-Z98-M78 as adopted under section 21 of The Elevator and Fixed Conveyances Act.

PETER LOUGHEED (Chairman)

ALBERTA REGULATION 161/71

(Filed June 9, 1971)

THE ELEVATOR AND FIXED CONVEYANCES ACT

(O.C. 1006/71)

Approved and Ordered,

GRANT MacEWAN,

Lieutenant Governor. Edmonton, June 8, 1971.

Upon recommendation of the Honourable the Minister of Labour, dated May 25, 1971, the Executive Council advises that the Lieutenant Governor in Council, pursuant to section 21, clause (*f*) of The Elevator and Fixed Conveyances Act, hereby makes regulations in accordance with the Appendix attached hereto, being a Schedule of Fees Payable in Respect of Inspections Made of Elevators and Fixed Conveyances or of any Class or Classes Thereof.

HARRY E. STROM (Chairman).

SCHEDULE OF FEES PAYABLE IN RESPECT OF INSPECTIONS MADE OF ELEVATORS AND FIXED CONVEYANCES OR OF ANY CLASS OR CLASSES THEREOF

1. Fees for regular inspections shall be at the following rates:

		Over 10 Floors
(a) Workmen's Hoists	$ 25.00	$40.00
(b) Passenger Elevators	25.00	40.00
(c) Freight Elevators	25.00	40.00
(d) Handpower Freight Elevators	10.00	
(e) Dumbwaiters	15.00	
(f) Escalators	25.00	
(g) Speed Walks and Speed Ramps	25.00	
(h) Employee's Belt-Lifts	20.00	
(i) Inclined Passenger Lifts	25.00	
(j) Private Residence Inclined Lifts	15.00	
(k) Aerial Tramways	200.00	
(l) Chairlifts	100.00	
(m) Ski Tows	25.00	
(n) Rope Tows	10.00	
(o) Mechanized Parking Garages	80.00	

2. (1) Fees for an initial inspection shall be triple the fee specified in section 1.

(2) Fees for a special inspection shall be double the fee specified in section 1.

3. When a special inspection is requested by the owner of an elevator or fixed conveyance or of any class or classes thereof, the owner shall remit the department an amount equal to the inspection fee applicable to the type of equipment inspected and the expenses incurred by the inspector at the current rate of Government travelling and subsistence allowances.

4. Every owner of a fixed conveyance or of any class or classes thereof shall be responsible for the payment of the inspection fees.

5. (1) Where an inspection fee is not paid within a period of ninety (90) days from the date of issue of the certificate or licence the Chief Inspector may cancel the certificate or licence and require that the fixed conveyance be taken out of service.

(2) Where a fixed conveyance is required to be taken out of service under subsection (1) an Inspector shall, on the direction of the Chief Inspector, seal the main service switch of the fixed conveyance in the manner specified by the Chief Inspector.

6. (1) No person shall

(a) break or remove a seal affixed to a fixed conveyance pursuant to section 5, except on the authority of an Inspector, or

(b) operate a fixed conveyance that is sealed pursuant to section 5.

(2) Where a seal affixed pursuant to section 5 is broken or removed without the authority of an Inspector, the owner of the fixed conveyance shall forthwith notify the Chief Inspector, in writing, of the break or removal.

7. Alberta Regulation 21/68 is rescinded.

8. This regulation shall come into force on the first day of January, 1972.

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